Interactive CAPTCHAs: Step forward or backward?

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Introduction

A CAPTCHA is a procedure that aims at giving access to humans, but blocking automated scripts. They are widely deployed as a method of preventing spam.
The term CAPTCHA (for Completely Automated Public Turing Test To Tell Computers and Humans Apart) was coined in 2000 by von Ahn, Blum, Hopper and Langford of CMU [CAPTCHA, AB+03].

CAPTCHA Evolution

The first CAPTCHAs were based on images of distorted characters, which is still the dominant approach adopted. Users have to read the characters and enter them into a text field. An increasing amount of distortion has been added to these CAPTCHAs to combat the rapid evolution of image processing and more specifically optical character recognition (OCR) algorithms. Approaches discussed in literature demonstrate that this category of CAPTCHAs are nonetheless legible to computers [MM03, YA07, HR10, BF+10]. Thus, alternatives to this method have been proposed.

Text based CAPTCHAs provide puzzles as plain text. This class of CAPTCHAs includes solving of simple mathematical expressions or completing sentences [G02]. A problem with the latter method is that clever algorithms can predict the likelihood of a given word occurring in a sentence, given the two previous words as context. Also, no OCR processing is required to analyse this class of CAPTCHAs.

Another category of CAPTCHAs displays a set of images together with a task to recognize and point to a certain image or subset of images [ED+07]. This class of CAPTCHA has a number of issues. If a user has to recognize a single image only, the success probability of random guessing becomes too high, while, the selection of multiple images places a high burden on the user. Finally, assembling a sufficiently large image database is not trivial, considering copyright issues (discussed below).

The major concern with CAPTCHAs from a *usability* perspective is that most of the present schemes are not accessible for humans who are blind, visually impaired or have a learning disability.

It is a well-known fact that under distortion some characters such as '1' and 'l', 'O' and '0', and '5' and 'S' have a high potential for confusion. This effect is further amplified by the fontface. To increase the effectiveness of CAPTCHAs against OCR-like attacks, Google and Yahoo! CAPTCHAs have created new confusing characters, such as 'vv' and 'w', 'cl' and 'd', and 'rn' and 'm' [YE08].

Major usability aspects which have not been investigated so far include the amount of time a user requires to solve a CAPTCHA tasks as well as the complexity of the task. These aspects are key when evaluating the applicability, cost and acceptance of a novel technology from a user perspective.

Interactive CAPTCHAs

In this paper we initiate first investigations on a novel category of CAPTCHAs. This class of CAPTCHAs involves a much higher interaction by the user than simply typing in a solution to some form of puzzle. The aim is to respond to the aforementioned issues of CAPTCHAs and to provide a more effective and more usable security measure.

Examples of Interactive CAPTCHAs are broad and range from simple activation of check boxes or moving a slider control to a certain position such as provided by the JQuery plug-in QapTcha [QapTcha] to interactive visual puzzles such as the KeyCaptcha service from ITNP JSC [KeyCaptcha] or rotating an image to its correct orientation as introduced by Google engineers [GKB09] and a similar approach rotating, moving and resizing 3D objects [WKB09].

We consider the current version of QapTcha to be insecure. It just uses a static puzzle, which can simply be circumvented by changing the content of one JavaScript variable, and by leaving a form field empty.

KeyCaptcha uses two kinds of CAPTCHAs. The first, "pairs of objects", requires the user to arrange pairs of objects. The challenge consists of two parts: First, the user has to decide which pairs match (e.g., because a similar color or color pattern appears in both objects). Second, the two objects have to be positioned according to a template shown in greyscale.

The second kind of CAPTCHA, called "puzzle" also involves arranging objects: An image is cut into

several rectangular pieces, which the user has to arrange to show the original image again. As an aid for the user, a small greyscale version of the original image is also shown.

In our opinion, neither CAPTCHA type is secure. The tasks to be performed by humans can also be achieved with simple algorithms: solutions can be (at least partly) verified using the greyscale template. Moreover, CAPTCHAs seem to be created by hand, reducing the number of possible variations.

From a usability viewpoint, the discussed Interactive CAPTCHAs (except QapTcha) do not provide basic usability properties, thus placing a burden on the user. They require too much time and complex thinking. Most of them are, moreover, not suited for humans with disabilities.

Image-based CAPTCHAs and copyright

[GKB09] is based on images found on the web; that principle might be applied for other CAPTCHAs. Unfortunately, a considerable fraction of images will be copyright protected. In Germany, this implies that the creator can forbid others from copying an image, and from making it available to the public.

The German Federal Court of Justice decided that posting an image on a website and making it available to search engines implies consent with the display of thumbnail versions on a search result page. Using arbitrary images found on the web for interactive CAPTCHAs is, most likely, not covered by that consent. As a result, copyright laws might make image-based CAPTCHAs very difficult to implement unless the operator has legal access to a sufficiently large number of images.

Conclusions and Outlook

CAPTCHAs are widely used to protect Web sites and services from misuse of automated programs called robots, although they do not provide an effective protection and are neither accessible nor usable. Instead of questioning the whole approach from the very root, novel approaches continue to appear. Interactive CAPTCHAs are amongst the newest developments. This paper initiated a first analysis of Interactive CAPTCHAs in terms of effective protection and usability. Both crucial demands are still unsatisfactory. Thus, the requirement for a more suitable replacement for CAPTCHAs still remains.

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