

Tabnabbing: The Attack That Exploits Human Wit

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Key words: Tabnabbing, phishing, client-side protection, Google Chrome, information

Abstract: In this era of information system where information is highly regarded, never the less, the information obtaining involves human interactions both physically and electronically. People often browse the Internet through browser and they might come across the attack known as phishing. As the technology and human creativity evolved, various methods also have been deployed to assist the phishing attack. One of the miscalled Tabnabbing attack by Raskin. Users used to browse using many tabs and may fall to Tabnabbing attack. The main goal of this project is to develop a solution for Tabnabbing attack in a form of web browser extension with the capability to detect and prevent user from falling for the attack. The project will cover only Google Chrome Browser and the prototype is developed by using JavaScript programming language, HTML and CSS. The prototype, named CTabs, implements the algorithm that captures the highlighted tab, comparing its screen shots of before and after the tab is switched, highlighting the differences and notify user through pop outs. As for the testing results, out of 4 tests, CTabs managed to pass all of them, detecting all of the Tabnabbing attack attempts. In short, CTabs managed to achieve the project objectives after the testing have been done.

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Page No.: 3101-3106

Volume: 15, Issue 16, 2020

ISSN: 1816-949x

Journal of Engineering and Applied Sciences

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INTRODUCTION

Social Engineering has always been the most powerful technique used by the malicious hackers in breaching the information security defenses, either of an organization or individual. Social Engineering can be defined as the attack that manipulates the human intelligence, making people submitting the information that should not be exposed to the unauthorized person. As

from the words of a researcher, "Social Engineering is a collection of techniques used to manipulate people into performing actions or divulging confidential information^[1]". One of the technology-based methods of Social Engineering is the Tabnabbing attack. Aza Raskin presented in 2010, a new type of phishing attack which he dubbed as "Tabnabbing". In this study, a countermeasure to combat "Tabnabbing" is presented, namely CTabs.

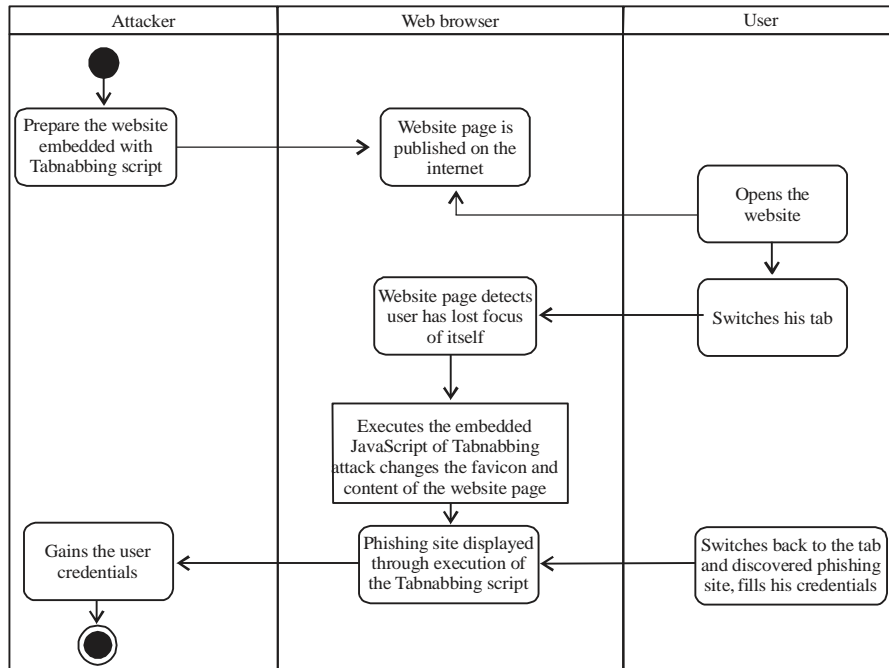


Fig. 1: Visualization of Tabnabbing attack flow

MATERIALS AND METHODS

Anatomy of a Tabnabbing attack: In 2010, Aza Raskin dubbed an attack that will assist phishing greatly with a name of “Tabnabbing” which elaborated more^[2] as Tab+Kidnapping. Firstly, Tabnabbing attack will be using tab mechanism which is widely used in all modern browsers. This attack targets in internet users who used to open multiple tabs on their browser at once. According to Raskin, an example of successful Tabnabbing attack will start with:

- Victim opened the page of the link and discovered a normal with non-harmful looking page
- The page will detect that it has not been interacted with for a while after being left unattended for a certain moment as victim switch his/her focus to the other tabs
- The page will replace its favicon, title and its contents with the phishing site or malicious script using JavaScript
- Using the page’s favicon and title visible by glancing at the tab, the victim will switch back to the page. There is a probability for the victim not to inspect the URL of the page
- If it is a phishing site, the victim will provide his/her credentials as he/she assumed that he/she has been logged out from the site. Otherwise, the malicious content of the page will be triggered and worked as the attacker intended

- After the victim has given the login information and the page has sent it back to the attacker’s server, the victim will be redirected to the original site imitated by the phishing site (Fig. 1)

Existing solution techniques and solutions for Tabnabbing attack: In this study, some of the existing techniques and solutions for confronting Tabnabbing attack will be discussed. From the research by Hashemi and Sadat^[3], there are generally two groups of techniques that can be used which are:

Script-blocking browser extensions: This provides protection against the script-based variant of the Tabnabbing attack. Browser extension that blocks scripts which are susceptible to perform malicious actions or violate the browser security policy. This protection is dependent on the default behavior of extensions towards preventing JavaScript code from execution on untrusted domains. These were stated by Hashemi and Sadat^[3].

- Specific designed Tabnabbing detection and prevention techniques
- Recording of favicon and a screenshot of a webpage once it is visited for the first time and once after a tab switch event occurs. Page titles and favicons are recorded for each tab. Results are based on Threshold value
- Using anomaly detection techniques on heuristic based metrics for conducting the comparison with respect to syntactical similarity

Table 1: Comparison of the existing Tabnabbing detection and prevention tools and techniques^[3]

Features	Script safe	Script defender	Tabs guard	CTabs
Use of whitelists	Yes	Yes	No	No
Use of blacklists	Yes	No	Yes	Yes
Browser	Chrome	Chrome and opera	Firefox	Chrome
Script-based attack prevention	Not by default	Yes	Yes (Active prevention)	Yes (passive prevention)
Script-free attack prevention	No	No	Yes (Active prevention)	Yes (passive prevention)
Technology in use to detect tabnabbing attack	Java script	Java script	HTML DOM; heuristics and data mining techniques	Screenshot comparison; threshold value

There are three existing solutions studied related to Tabnabbing attack which are Script Defender, ScriptSafe and TabsGuard.

Script defender: Script Defender is an extension for Google Chrome and Opera browser which use the whitelisting method to allow the site for user to interact with it. This extension can block the unwanted scripts, plugins and other annoying page elements. This solution includes the usage of whitelist but not blacklist. However, it does not prevent script-free attack but prevents script-based attack.

ScriptSafe: As defined by Williams², ScriptSafe is an extension for Google Chrome browser which can selectively block many types of web content and technologies and prevent multiple low-level privacy leaks.

TabsGuard: TabsGuard is an extension for FireFox browser which is proposed and developed^[3]. It is a hybrid anti-tabnabbing approach which combines heuristic-based metrics and anomaly detection techniques. This solution includes usage of blacklist but not whitelist. It also prevents script-free attack and script-based attack actively (Table 1).

CTabs prototype: In this study, the idea of CTags is discussed including the system flow and algorithm.

Core idea: A successful Tabnabbing attack will depend on the user low awareness regarding his/her browsing activity. Upon visiting the malicious site, shifting focus on different tab and returning after some time, user will discover that the malicious page has changed its looks to resemble a popular application’s login form. A Tabnabbing attack is obvious to identify, since, a phishing page will contrast from the past substance. Detecting is however, muddled by the tab being out of focus and the client setting some trust in previously opened and visited tabs.

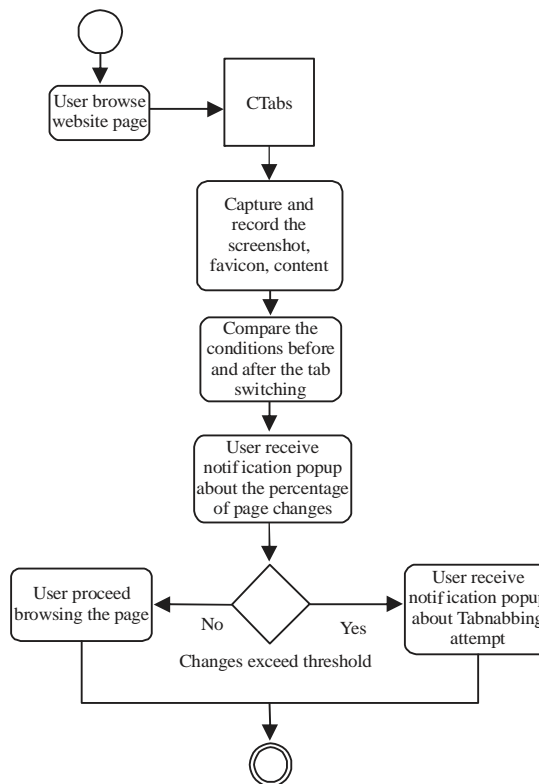


Fig. 2: System flow

CTabs will grab the benefit of these obvious changes by recording what the tab looks like before it loses focus and comparing its condition to what it looks like when it regains focus. Any differences that happened in the background will be detected and be notified to user by the means of a red-colored overlay and few warning popup. This will allow user to decide either the changes are harmful or not.

System flow and architecture: Figure 2 and 3 depicts CTags system flow while Fig. 4 depicts CTags system architecture. CTags will capture and record the condition of the tab. User then switch to another tab and then switch back to the previous tab. CTags then will compare the current tab condition to the condition before. Percentage of the difference between the two conditions will be notified to the user through popup. If the percentage exceed the threshold, warning notification will be triggered about an attempt of Tabnabbing attack. If not exceeding the threshold, user will resume his browsing activity.

Functionality: In this study, the functionality of CTags are discussed in detail. Currently, there are six major functions which are.

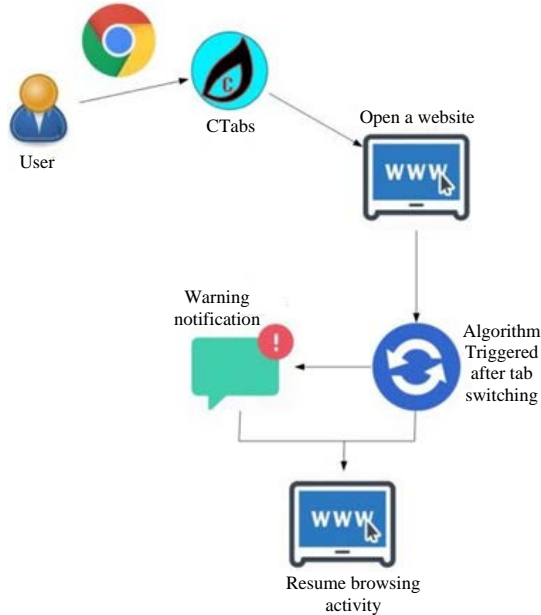


Fig. 3: System architecture



Fig. 4: CTags highlighted the area that has been changed using the red-colored overlay

Capturing tab condition: This function is consisted of methods that will capture the condition of the particular page including its favicon. Google Chrome has an API that can identify the selected tab by its ID and currently visible tab of a window. To output all of the processes that can be output, a method of Logger is developed.

Comparing tab condition: This function is consisted of methods that will compare the screen shots of the selected tab before and after it has gained focus. The screen shots will be compared using an algorithm. The algorithm will be implementing HTML5 canvas element for the screen shots, cutting and dividing the min to fixed-size. (e.g., 10×10 pixels). For the favicon, they will be compared by source.

Highlighting area changed: This function is consisted of methods that will highlight the area that has been changed

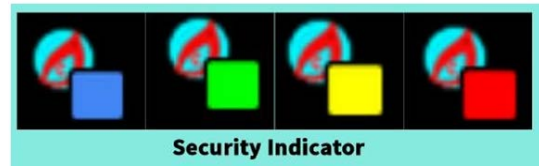


Fig. 5: CTags icon colour

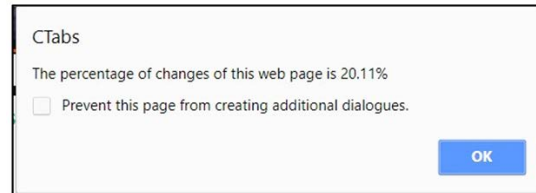


Fig. 6: CTags notification about the changes percentage

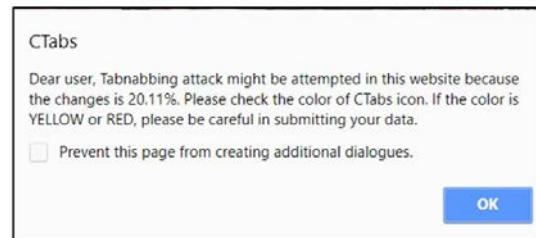


Fig. 7: CTags notification about the potential attempt of Tabnabbing

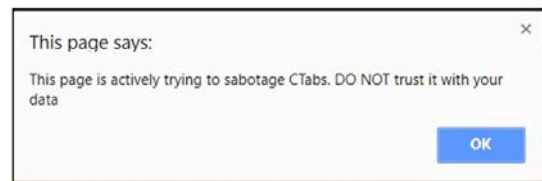


Fig. 8: CTags sabotage detection notification will be triggered if the page removed the red-colored overlay

after the selected tab is switched back. Implementing overlay element, CTags will inject a red-colored overlay of the provided results in to the page, highlighting the differences in the page. Fig. 4 depicts the example of highlighting the changes on the web page.

Icon indicator: This function that will change the color of the CTags icon, based on the result of the comparison which are (Fig. 5-8):

- Green: the changes are <10%
- Yellow: the changes are <40%

- Red: the changes are <40%
- Blue: indicates that CTags is in the stand by mode

Notification pop out: This function is consisted of methods that will notify the user of the result of the comparison in percentage, warning the user and also notify the user to check the color of the CTags icon.

Sabotage detection function: This function is consisted of methods that will alert user if the compared page tried to remove the red-colored overlay injected by the CTags. Five of the six functions above are inspired from^[4].

RESULTS AND DISCUSSION

In this study, the testing of CTags prototype are discussed and also the conclusion of this project. CTags is implemented in Google Chrome browser as extension. For the testing, White Box Testing and Simulation of Tabnabbing attack were done to test the capabilities of CTags.

Sabotage detection function testing: For the first testing, it is related to the Sabotage Detection function. For this test, three users of CTags were tested against a page armed with Tabnabbing attack code and the results were depicted in a form of bar chart.

Table 2 explained CTags results in detecting removal of the red-colored overlay by Test Page1. The results of the scores are based on Fig. 9. The testis successful because the detection worked and notification pop out is showing the message. This is the sign that CTags is safe from being compromised its highlighting of changed areas.

Legitimate page testing: For CTags, white box testing had been performed against legitimate pages that are well

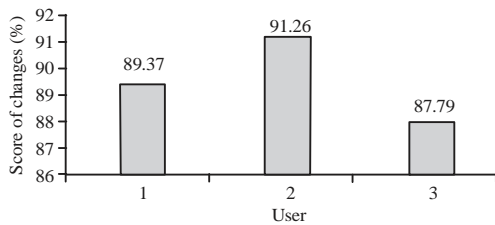


Fig. 9: Average score results produced by CTags against Test Page 1

Name	Sabotage detection function testing
Date	2nd September 2017
Description	To test whether the detection of red-colored overlay removal is successful or not
Expected	Sabotage notification is popped out
Result	Warning notification is popped out
Result	Sabotage notification appeared accordingly and also the warning notification

known their trustworthiness. The objective of this test is to evaluate how well CTags can provide the score the legitimate pages.

Table 3 explained CTags results against 10 different legitimate pages. The results of the scores are based on Fig. 10. The test is partially successful as there are only four pages that achieved the expected result while the other six are not.

The unexpected results are because of the tested pages are dynamic and they have web page components that constantly changing over time, resulting false positive outputs of CTags. Examples of the web page components are the advertisements and the image-slider.

CTags against self-made Tabnabbing page testing: In this test, a Tabnabbing page was made and was tested against CTags.

Table 4 explained the CTags test result against self-made Tabnabbing page. The result of the score are based on Fig. 11 where the most significant score that CTags computed is 91.26%. It showed that the test is successful in detecting Tabnabbing attack and next, preventing user from giving away his or her credentials through the warning notification.

CTags against Tabnabbing page created by using SE Toolkit: In this of testing, Tabnabbing attack was executed through Kali Linux and Windows 10 confronted it using CTags^[5, 6].

Table 5 explained the CTags test result Tabnabbing page created by using SE Toolkit. The score result was based on Fig. 12 and it shows that the highest score is 89.99%. By running this test, its result is expected to achieve at least 40% of changes and popped out the warning notification. After testing has been done, the actual result matches the expected result. This proved that CTags is useful to confront Tabnabbing attack launched by using SE Toolkit.

Name	Legitimate Page Testing
Date	11th September 2017
Description	To test whether CTags can provide reasonable score for the legitimate pages
Expected	The score of the comparisons all are below 10% and no alert notification triggered
Result	6 pages were scored averagely over 10% and alert notifications were triggered but not sabotage notification

Name	CTags against self-made Tabnabbing page testing
Date	20th September 2017
Description	To test whether CTags can detect Tabnabbing attack and provide expected output
Expected	The score of the comparisons all are above 40%
Result	Warning notification is popped out
Result	PASSED all CTags users received score over than 40% and alert notifications were triggered

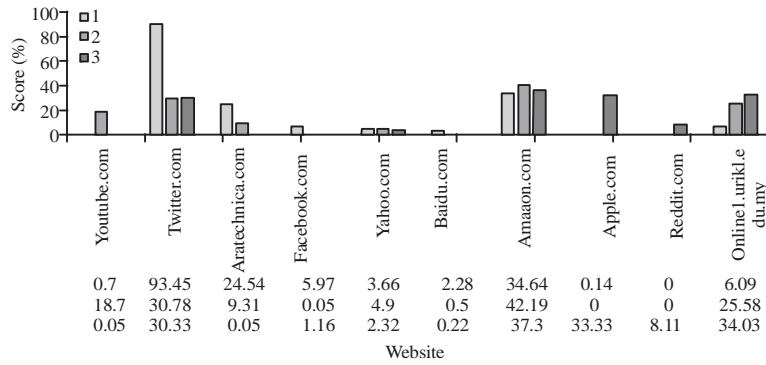


Fig. 10: Average score results produced by CTags against 10 different legitimate pages

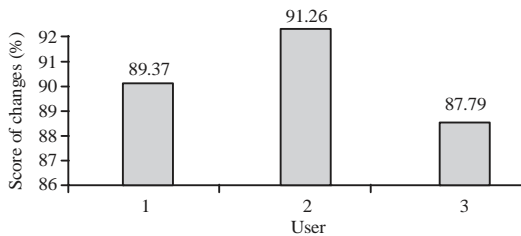


Fig. 11: Average score results produced by CTags against Test Page 2

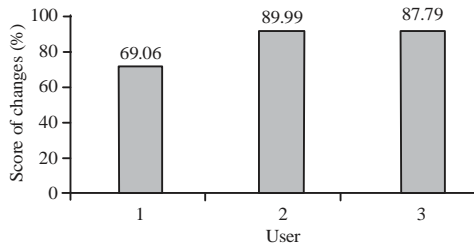


Fig. 12: Average score results produced by CTags against Tabnabbing page of SE Toolkit

Table 5: CTags testing result against Tabnabbing page created by using SE Toolkit

CTags against Tabnabbing page created by using SE Toolkit	
Name	CTags against Tabnabbing page created by using SE Toolkit
Date	25th September 2017
Description	To test whether CTags can detect Tabnabbing attack from the SE Toolkit and provide expected output
Expected result	The score of the comparisons all are above 40% Warning notification is popped out
Result	PASSED All CTags users received score over than 40% and alert notifications were triggered

CONCLUSION

In the nutshell, Tabnabbing attack is a part of phishing attack where the situation is the hacker exploits the trust a user places in previously opened browser tabs. This could happen by making the tab changes its look to a legitimate login form of a known web application while user is not focus on it. The tests for CTags proved its

capabilities in detecting and preventing user from falling victim to Tabnabbing attack with 100% of the simulation attacks were successfully confronted and gained expected out puts. However in one part of the testing of CTags against legitimate pages, 60% of the pages tested fell into the suspected Tabnabbing attack, caused by the dynamic web design. But that will not be the main issue as users can determines themselves whether should insert credentials or not based on the URL. Furthermore, there are lot of current solutions for this type attack, still ignorant user falls for this attack easily. Other current countermeasures typically depend on several specific methodologies and requirements of Tabnabbing attack and are easily by passed. However, this developed countermeasure of CTags is the first to do a fully visual comparison followed by highlighting the differences and next giving warning notification to the user if any potential Tabnabbing attempt is suspected.

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