Security analysis of web-based collaborative platforms

Project Proposal

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Content

1 Abstract

With the advent of the digital age, web-based collaboration platforms have become indispensable in business, organizations, and education. These platforms provide great convenience for tasks such as real-time communication, document sharing, and project management, significantly improving productivity. However, with their widespread adoption, security concerns have become increasingly prominent. Common security threats include data leakage, malware attacks, and phishing attacks, which can lead to unauthorized access or theft of users' sensitive information (e.g., personal, financial, or medical records). The purpose of this paper is to provide a systematic assessment of the security features of current web-based collaboration platforms, focusing on their performance in preventing cyber-attacks, protecting user privacy, and maintaining data integrity. The study will combine a literature review and data analysis to demonstrate the distribution and classification of security issues on platforms like Google Workspace, explore the main reasons why malicious applications are taken down, and propose practical recommendations to improve the security of collaboration platforms. Through this study, it is hoped that valuable insights will be provided to developers and platform operators to optimize overall platform security and address potential future security threats.

2 Background and Literature Review

2.1 Introduction

With the rapid growth of digitization, web-based collaborative platforms have become indispensable for businesses and organizations. These utilities, which support tasks such as document sharing, real-time communication, and project management, greatly enhance efficiency. However, as these platforms are increasingly adopted, security issues are emerging (Chia et al., 2021). Examples of such attacks include data breaches, where involved personnel or attackers can access sensitive information: personal, financial, and medical records, among others (Alazab et al.,2015). Attackers design and deploy malware as common forms of computer-damaging agents, data-stealing programs, or system-commandeering

applications like computer viruses, worms, Trojans, and ransomware. Phishing entails attackers imitating or taking another identity as the right communication, either through emails or websites, to deceive users into the release of personal information or login credentials (Hong, 2012). This, therefore, makes such a security platform a burning issue that needs to be taken care of.

Initially, collaboration tools such as those by Microsoft were based on localized installations, limiting users to internal network communication. A major breakthrough in collaborative technology occurred with the advent of SaaS (Software as a Service) models, enabling users to collaborate across devices and locations in real-time, as seen with platforms like Google Workspace and Microsoft Teams. This innovation significantly boosted enterprise efficiency but also introduced new cybersecurity challenges (Zhao et al., 2020).

For instance, in 2020, during the COVID-19 pandemic, the rapid shift to remote work caused Zoom's user base to grow from 10 million to 300 million, but this also exposed security vulnerabilities. Yet the same phenomenon gave rise to security concerns about their susceptibility to security challenges such as "Zoom bombing" and not having sufficient encryption. For example, since Zoom meetings do not provide enough controlling features, including meeting lock and password protection, other, bad actors are enabled to randomly generate or guess meeting IDs and join meetings without permission and hence cause a disturbance to the proceedings. A similar loophole has been responsible for malicious interruptions in thousands of public meetings, according to Johnson and Robinson (2020). It served to, therefore, expose collaborative platforms to the weaknesses to protect the privacy and data of the users (Tucke & Brey 2021). This raised a big buzz and got Zoom as well as other collaboration tool providers to squarely focus on a major overhaul of their security.

The primary focus of this study is to answer several questions. What is distribution, and in which set of security issues does dissimilarity exist with platforms? How does classification assist in understanding these applications? What are the main reasons for the delisting of an application due to age? Are the reasons similar for malware or security inconsistencies? These questions uncover unique challenges and trends in application security

for across all types of devices. It expertly guides developers and platform operators in making the right decisions toward future security threats, and the optimization of overall platform security performance.

To tackle these problems, I will first conduct a plentiful literature review to ensure the accuracy of the research direction and to find valuable references by analyzing the existing theoretical foundation. Second, I will collect relevant data using experiments, organizing and classifying it into details, to understand better the behavior patterns of applications and the basis of their classification. Finally, I will perform a detailed analysis to identify the causes of malicious applications and their impact on user security, identifying key security concerns.

2.2 Literature Review

2.2.1 Introduction

With the rapid growth of mobile internet and app markets, the diversity, convenience, and possibility of reaching as many users as possible have made Google applications be applied to all sides of life and work, among other factors (Zhao et al.,2020). These are attempts at allowing users to have relatively efficient service experiences while evading the traditional optimization and resource consumption matters concerning application performance (Li et al., 2021). The number of Google applications has indeed multiplied over the years, mostly within the Google Workspace. This has increased engagement not only of developers and users but also increased the number of applications—hence, the ability to manage and categorize them properly—effortlessly while at the same time maintaining their security and functionality—becomes imperative with every addition(zhang et al., 2019). On the other hand, some applications have also been slowly withdrawn on the grounds of malware, information theft, and many more, which thereby raises security concerns. Thus, the current research is turned to regard the quantity and categorization of Google applications through data collection using analysis of algorithms and an analysis of the phenomenon of applications being out-of-date and the reasons for that.

This review will be an all-round analysis of the numbers and classification of the applications within Google Workspace, focusing on what data from Google Workspace, in general, is brought together and analyzed to research these applications and their distribution and development tendencies in different markets. Yet, in previous years, the general active usage of Google Workspace applications around the world has had continuous attention by researchers and developers on its security, functionality, and methods of categorization (Sadiq et al., 2021). Through the analysis of the quantity and distribution of Google applications, such research work may indicate that these rates of growth, user behavior patterns, and developer strategies will be treated as a precondition of future technological development and market optimization on diverse platforms.

This review will focus on the following: quantification and distribution of applications using platforms such as Google and GitHub; in-depth analysis of the different markets according to the applied classification methods of applications; studying the automation aspect of categorization algorithms; comparison of classification criteria of different markets. Finally, the research will also take a closer look into the phenomenon of the older applications and the reason why such applications are removed from the stores, is it due to their low user rating, decreased download volume over time, or their takedown after being detected as containing malware.

The paper will be anchored by several peer-reviewed articles, summarizing the theories from previous printed materials and bringing to light issues that need attention. This will be followed by a review that summarizes the related issues of concern to these issues, while critically pointing out the insufficiencies of such solutions by summarizing journal reports with differing viewpoints. We hope this will have afforded some guidance and constructive direction for our future applications, improving available developers' considerations in the development of web-based collaborative platforms.

2.2.2 Body

The increase in the use of applications within Google Workspace is rapid due to the fast development of mobile internet and the convenience it demands from users (Google, 2021). The development of Google Workspace has managed to give the market numerous applications that can easily be accessed by users, enabling a wide range of powerful functioning tools to be accessed easily without any kind of complicated installation process (Smith, 2020). What differentiates these web-based applications is that they quickly attracted world attention to become the darling platform for many developers and businesses alike (Jones et al., 2019). In the initial design, the Google applications were meant to cut down the development and use barriers, where the user would easily install applications through a simple click from the app store while the developer could publish and even maintain their applications through the Google Workspace platform (Brown et al., 2021). That, in turn, means that Google Workspace apps offer not just convenience and flexibility but also can bring out more detailed discussions regarding their mechanisms of security and management.

One of the factors contributing to this is the development of mobile internet rapidly, and there is a demand for handy applications by the consumer population (Lee & Kim, 2020). In the Google Workspace platform, offers a rich amount of applications, allowing rapid access to very powerful tools without the need for a cumbersome installation process(Martinez, 2019). These cloud-based applications have received global prominence and are recognized as the most preferred mediums by numerous developers and businesses across the globe (Davis et al., 2021). The original principle of Google applications was to alleviate the development and use of workloads, with the availability of applications on a single click to install in the app store on the part of users and application publishing and maintenance being simplified by the Google Workspace on the part of developers (Jackson et al., 2020). In return, Google apps make for greater convenience, flexibility, and further debates about their security and management mechanisms.

On one hand, some researchers argue that the diversity and convenience of applications provided by Google have made those applications highly adopted all over the world. To this extent, Singh and Chatterjee (2021) posit that the design adopted for such applications allows a user to access very many functions quickly within a glance without taking too much space on the device, hence increasing the frequency at which a user regularly uses preinstalled Google apps（Singh & Chatterjee, 2021）. More evidence for this is how Zhang et al. state that, since Google applications do not have a complex installation process and their scenarios for use are flexible, they can meet a wide range of daily and work needs (Zhang, Wang, & Li, 2019). Their diversified and user-friendly properties have greatly reduced the usage threshold and saved a part of the maintenance cost for developers, which is an important means of promoting the Google platform (Lee & Kim, 2020), namely, helping developers enhance the management of applications and increase their functional betterment. For instance, a recommendation system can intelligently push relevant applications according to user's preferences, thus increasing user interaction and satisfaction (Wang et al., 2021). Thus, most people think that the popularity and wide application of Google applications largely lie in its flexibility, ease of use, and advantages of low cost (Singh & Chatterjee, 2021).

However, Johnson et al. (2020) presented a different view on the status of security. As Google Workspace applications continued to grow at an exponential speed, there also emerged numerous security threats to the leasing platform. Some of the applications were harnessed a means through which malware infringed sensitive data and thus exposed users to risks of data leakage or privacy violation (Johnson & Lee, 2020). These malicious apps often masquerade as legitimate ones, engaging in phishing, ad fraud, and even data theft, thereby posing significant threats to both users and the platform（Johnson et al., 2020）. Brown et al. (2021) observed this when they indicated that during the fast growth of Google Workspace, the absence of app vetting and other security mechanisms allowed malware to pass through (Brown, Gupta, & Patel, 2021). Consequently, the company should consolidate the conduct of security reviews and security management while promoting the Google Workspace applications to avoid spreading the malware (Johnson et al., 2020).

Liu and Zhu (2019) argued from yet another perspective by stating that the elimination and obsolescence of some small apps are directly no security issues (Liu & Zhu, 2019). They said that although some applications would need to be kicked out due to security concerns, some of the small programs have been kicked out by the two big factors of market saturation and change in demand from the users. For example, when new applications come out with a lot more functionality, or some technological updates replace the function of those older programs, these old applications would become radically anti-competitive in the market (Liu & Zhu, 2019). Also, Zhang et al. (2020) pointed out that the general soft-attrition of the user tastes will lead to the loss in user base of some small programs, which will eventually be phased out by the market; hence, reinforcing the viewpoint of Liu & Zhu (Zhang et al., 2020).

Researchers have concurred that increasing applications with wide usage, convenience, or causing security problems, must be more fine-grained in management, especially in classification and security. Classification algorithms may support the developers in the effective management of small programs, thereby offering an enhanced user experience at the end (Zhang et al., 2020). At the same time, guarantees of security for small programs and advanced prevention of malware are key prerequisites for the satisfaction of user privacy and the stability of the platform reposting (Arora & Kumar, 2022).

The present studies reveal that the questions of the number, classification, and security of the already existing Google applications are progressively coming to the center of academic and industrial attention. Research finds that classification technologies based on data collection and algorithms can effectively work with large volumes of small programs and ensure their safety (Kumar et al., 2021). What is more, old applications receive user reviews and ratings, and such an analysis may bear a relation to the removal reasons, which is used by developers in improving on security strategies and user experience on their platforms (Liu & Zhu, 2019). Generally, with Google applications becoming persistent in the world, deep research into their classification and security turns into significant academic and practical interest.

2.2.3 Conclusion

Those reviews in the existing literature share a specific thread of easy installation, low entry barriers, and rapid global adoption regarding the applications developed by Google. Most researchers generally agree that Google applications reduce the storage space of a user's device, hence improving both user experience and development efficiency (Chen et al., 2019). For example, from a viewpoint of classification and management, it involves algorithms like K-means and SVM, which provide effective management options for application functionality to the developer for further optimization of the user experience（Zhang et al., 2020）. When coming down to application security, in this context, Sun et al. (2018) and Kumar et al. (2021) have both opined that with the increase in applications, malware proliferation and exposure of user data are emerging security issues that put much greater requirements on the reviewing mechanisms and managing mechanisms of the platform.

The most conspicuous differences, however, lie in the reasons behind the obsoletion and delisting of Google apps. Some scholars believe that major reasons for removing some apps involve security problems, such as malware and data leakage (Sun et al., 2018), while some researchers contend that market saturation, variations of user demand, and technology updates are more burning issues as to why apps face gradual phasing out (Liu & Zhu, 2019). The two are essential views to various insights into understanding the lifecycle and removal mechanisms of Google applications.

Despite thorough research into the classification and security problems of Google apps, there are still areas unsolved. One example of such an area is how to better integrate algorithms of classification with security monitoring in further assisting the platforms to improve user experience while ensuring data security.

Therefore, with the proliferation of Google applications around the globe, a huge number of user bases and diversity bring great convenience to developers and users. However, quite several issues about classification management and security are emerging accordingly. In the future, it is supposed that more research shall be focused on how integration of algorithms,

technology, and platform management can further enhance application security and users' experience, and provide stronger support for academic study and practical application in this field.

2.3 Research Aim

This work mainly aims at the systematic review of security features of web-based collaboration tools in respect of protection against cyber attacks, preservation of user privacy, and integrity of data. Security issues, like user data breaches, unauthorized access, malware attacks, and so on, slowly expose themselves on a web-based collaborative platform, with an increasing use on the other hand. Hence, this study brings forward practical suggestions towards the improvement in collaborative platforms security by addressing the following major objectives:

1. Web Scraping for data collection: A web scraping tool should be designed to collect data of applications available on the Google Workspace and GitHub platforms. This will be used in the automatic collection of basic information concerning the various applications, including its name, functionality, rating, download count, etc., and to analyze the distribution of programs across different platforms. This data collection exercise will help to learn the number of applications available on Google Workspace and GitHub, the functional categories, and the market trend—that is, the foundational data for further classification and security research.

2. It will be classified whether the classification is different across platforms with regard to applications from Google Workspace and GitHub. This research shall, therefore, provide insights to be used in optimizing the management and recommendation of Google Workspace applications in the future by understanding how different classification systems impact user experience and security.

3. Analysis of Outdated Applications and the Reasons for Removal: Many applications, upon release, gradually die out or get removed because of malicious behavior, reduced

demand from users, or simple technological changes. In this research, such outdated applications will be analyzed, and an attempt will be made to identify major reasons for their removal. Data on user feedback, ratings, and downloads will be obtained, and using this information in conjunction with the data obtained by the web scraping tool, it will be established whether these applications were removed because of malware, data theft, or any other security-related issues. User reviews and ratings will also be analyzed in an attempt to establish other possible reasons for removal, like poor user satisfaction and complaints.

4. Application Security—Vulnerability Analysis in Communication between Applications and Google Workspace: This study is going to analyze the vulnerabilities in the communication processes between applications and Google Workspace. We will know all the workflows of the applications comprehensively to identify security weaknesses like common web attacks such as XSS and SQL Injection. Furthermore, this research will be supported by the analysis of open-source code in the GitHub platform to find out security risks and possible vulnerabilities. This section, therefore, aims to provide recommendations on enhancing security in relation to Google Workspace applications and GitHub open-source projects by conducting the analysis of vulnerabilities to reduce the risks of cyber threats.

3 Program and Design of the Research Investigation

3.1 Methodology

The researchers should employ the right methodology to conduct the necessary topics for the classification and security of a large number of small applications. Zhang et al. (2020) argued that classifying a large number of small applications based on machine learning algorithms has seen high maturity, such as K-means and SVM. The algorithms automatically classify a massive amount of data to identify the different types of small applications and

assess the security of the applications. Similarly, Wang et all recommended the use of web scraping mechanisms to gather reviews, and download counts for the smaller applications, and thereby further analysis can be done towards the app user feedback and its impact on the ecosystem of the platform. In this way, much can be learned regarding the distribution, popularity, and potential security problems of small applications on the market.

Otherwise, the application of supervised learning is a vital aspect to consider while dealing with the number, classification, and security of application studies. There can generally be categorized into two types of training; supervised training and unsupervised training, an approach that has situational advantages. The former relies on the labeled dataset, where each input sample has an attached output label (Zhou et al., 2021). In application classification, one may apply supervised learning with labeled data, for instance from users indicating labels of malicious apps, download counts, and user ratings, among others. Such data will then be used to classify new applications and rate their security (Gupta & Garg, 2020). In contrast to supervised learning, unsupervised learning does not depend on labeled data but classifies or clusters what it finds in a 'dark' way with hidden patterns or structures in the given data, also called unlabeled data nowadays (Basu et al., 2019). In applications, typical unsupervised learning algorithms are K-means clustering and Principal Component Analysis (PCA) in the form of classification research (Wang et al., 2020). These algorithms can assist researchers in automatically discovering similarities between applications, including their classification when explicit labels are not available (Singh et al., 2020).

3.2 Research Plan

In the course of this research, a lot of Python programming will be practiced in functions such as writing automation scripts and data scraping. Despite being a development engineer specializing in Java, I am quite new to the Python programming language and its syntax. As such, I will have to systematically learn the basic syntax of Python and its related frameworks throughout the research to ensure that I can complete all tasks. Furthering my skills in Python allows me to manage data more effectively in my research and ensure the consistency and

reliability of the results.

A second key agenda for this research is to amass a good amount of data about web-based applications and analyze whether this data suggests any security concerns. For this purpose, a few experiments need to be carried out to overcome the pitfalls and incompleteness of the collected data, that is only possible by writing appropriate Python scripts that will possibly help automate the process of collection and further, various security testing methodologies will have to be placed to discover potential vulnerabilities.

Summarizing and further optimizing the existing security issues on web-based collaboration platforms shall be done through feedback analysis of the experimental data. I will provide a deep analysis of the collected data and come up with optimization solutions to enhance their safety. I have prepared a very specific timeline, which is likely to assist a lot in the abundant completion of learning Python, data collection, and experiments as well as in data analysis and report writing. I will strictly follow this to ensure the project gets completed on time and with high quality. In the table, the green part is completed, and the other part is incomplete.

Timetable for Semester 1

Time Point	Event
7.30-8.12	Learn to carry out web scraping: target Google Play Store and GitHub. Master related technologies about scrapping. Read relevant literature. Prepare scapping scripts and collect preliminary data of Google and GitHub applications.
8.12-8.22	Review and summarize relevant literature, prepare the project plan for

	the project proposal.
8.22-9.3	Appropriate web-scraping techniques over the Google Play Store and GitHub platforms can be put in action to start collecting data regarding different applications, ranging from application ratings and download counts to user comments. Initiate preliminary data analysis; document algorithms and experimental results.
9.3-9.25	Roughly categorize the data according to the information obtained by web scraping applications. All the efforts, including the existing classification algorithms, rough classification experiments, data in different market analyses, and preparation of the report for the workshop, must be directed toward data preparation. Proceed to further scraping scripts optimization and data collection.
9.25-10.2	Carry out the preliminary results of the classification algorithm studies in the workshop, fine-tune the algorithms, conduct detailed analyses, and kick start the evaluation with outdated applications, which should include, among other things, a collection of

	review, rating, download count data, and the reason behind its removal.
10.2-10.9	Draw from the experimental results in the first paper, propose potential research questions, and analyze the scope for further extension and refinements.
10.9-10.23	Investigation on old applications data by removing it, analyzing the reasons, detecting the behaviors of malicious software, validating the assumed concepts, and preparing to classify the model to optimize. Complete the report of analysis regarding this stage.
10.23-11.16	Activities include proceeding with the process of sorting data and finalizing the contents of the experiment and analysis report for the first semester, preparing for the stages of the second semester.

Timetable for Semester 2

Time Point	Event
2.16-3.1	Specialization of the algorithms by the provided data and the preliminary classification models elaborated in the

	first semester. New methods will include more sophisticated machine learning classification algorithms.
3.1-3.21	Vulnerability analysis: Know the workflow of programs, identify the weak points, and the consequences they cause. Classify the identified vulnerabilities and record experimental data. Preparation of workshop report.
3.21-4.15	Analyzing open-source code on GitHub.
4.15-5.1	Propose improved classification algorithms and malicious behavior detection models, and combine the previous research results to analyze various platforms, showing differences between them.
5.1-5.15	Integrate all experimental results and draft the initial analysis report. Start in-depth comparisons and analyses; write the first draft of the paper.
5.15-5.30	Participate in the final summary meeting; discuss final experimental results and improved models; write the paper for further refinement; prepare for submission of the conference paper.
5.30-6.10	Finalize last experiments and optimizations; participate in final

	presentation; discuss with and confirm final revisions from supervisor; refine draft.
6.10-6.15	Finish the last review of the paper and submit the final version.
	Project complete!

3.3 Risk analysis

The main risks in my project include the following areas: time management, technical difficulties, data collection, etc. Firstly, for the time management risk, the programming language used in this project is python and the applications in Google Workspace and GitHub need to be crawled, and after crawling these applications need to be classified and analysed. Therefore this requires reasonable time allocation and scheduling. As a JAVA development engineer, I need to master the python language quickly and need to allocate time for crawling, classification and analysis in a reasonable manner. In addition, in the process of data crawling, as the web pages in Google Workspace and github may be updated at any time, which leads to some applications can not be accessed through the previous URL, so there may be incomplete data in data collection, leading to insufficient data, which affects the accuracy of the experiments and the conclusions of the study. Therefore solving the data collection problem is also something to focus on. Finally, the difficulties of this project lie in writing crawler scripts, data crawling, classification algorithms and so on. In order to ensure the smooth progress of the project, we need to collect the literature in advance and check the open source code to solve the technical difficulties of the project.

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