A Novel Phishing Website Detection Approach Using Machine Learning

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***Abstract*——Phishing attackers spread phishing links through email, text messages, and social media platforms. They use social engineering skills to trick users into visiting phishing websites and entering crucial personal information. In the end, the stolen personal information is used to defraud the trust of regular websites or financial institutions to obtain illegal benefits. With the development and applications of machine learning technology, many machine learning-based solutions for detecting phishing have been proposed. Some solutions are based on the features extracted by rules, and some of the features need to rely on third party services, which will cause instability and time-consuming issues in the prediction service. In this project, we propose a machine learning-based framework for detecting phishing websites. We have implemented the framework as a browser plug-in capable of determining whether there is a phishing risk in real-time when the user visits a web page and gives a warning message. The real-time prediction service combines multiple strategies to improve accuracy, reduce false alarm rates, and reduce calculation time, including whitelist filtering, blacklist interception, and machine learning (ML) prediction. In the ML prediction module, we compared multiple machine learning models using several datasets.**

***Index Terms*—Phishing, Personal information, Machine Learning, Malicious links, Phishing domain characteristics, Phishing attacks, legitimate, trust worthy**

I. Introduction

Phishing is a kind of Cyber crime trying to obtain important or confidential information from users which is usually carried out by creating a counterfeit website that mimics a legitimate website. Phishing attacks employ a variety of techniques such as link manipulation, filter evasion, website forgery, covert redirect, and social engineering. The most common approach is to set up a spoofing web page that imitates a legitimate website. These type of attacks were top concerns in the latest 2018 Internet Crime Report, issued by the U.S. Federal Bureau of Investigations Internet Crime Complaint Center (IC3). The statistics gathered by the FBIs IC3 for 2018 showed that internet-based theft, fraud, and exploitation remain pervasive and were responsible for a staggering 2.7 billion in financial losses in 2018. In that year, the IC3 received 20,373 complaints against business email compromise (BEC) and email account compromise (EAC), with losses of more than 1.2 billion. The report notes that the number of these sophisticated attacks have grown increasingly in recent years. Anti-Phishing Working Group(APWG) emphasizes that phishing attacks have grown in recent years, Figure 1 illustrates the total number of phishing sites detected by APWG in the first quarter of 2020 and the last quarter of 2019. This number has a gradual growth raising from 162,155 in the last quarter of 2019 to 165,772 cases in the first quarter of 2020. Phishing has caused severe damages to many organizations and the global economy, in the fourth quarter of 2019, APWG member OpSec Security found that SaaS and webmail sites remained the most frequent targets of phishing attacks. Phishers continue to harvest credentials from these targets by operating BEC and subsequently gain access to corporate SaaS accounts. Many approaches have been used to filter out phishing websites. Each of these methods is appliable on different stages of attack flow, for example, network-level protection, authentication, client-side tool, user education, server-side filters, and classifiers.

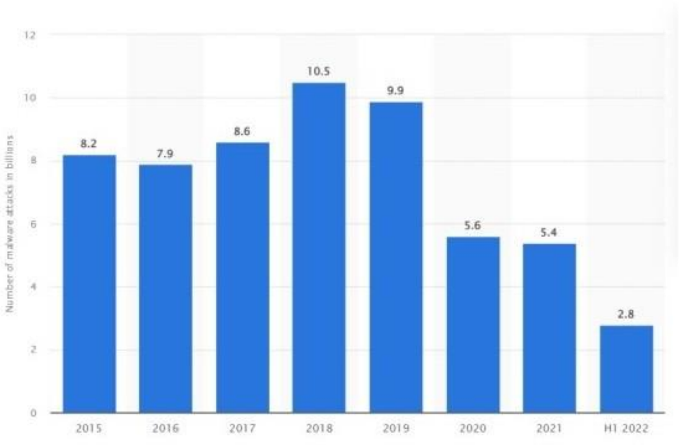


Fig. 1. Graph Design

II. Ease of Use

A. PROBLEM DEFINITION

Nowadays Phishing becomes a main area of concern for security researchers because it is not difficult to create the fake website which looks so close to legitimate website. Experts can identify fake websites but not all the users can identify the fake website and such users become the victim of phishing attack. Main aim of the attacker is to steal banks account credentials. Phishing attacks are becoming successful because lack of user awareness. Since phishing attack exploits the weaknesses found in users, it is very difficult to mitigate them but it is very important to enhance phishing detection techniques. Phishing may be a style of broad extortion that happens once pernicious website act sort of a real one memory that the last word objective to accumulate unstable info, as an example, passwords, account focal points, or MasterCard numbers.

B. OBJECTIVE

The main objective of this research is to develop a machine learning-based phishing detection system that can help users to check the legitimacy and maliciousness of an URL within a minimum amount of time. To develop a novel approach to detect malicious URL and alert users. To apply ML techniques in the proposed approach in order to analyse the real time URLs and produce effective results. To implement the concept of RNN, which is a familiar ML technique that has the capability to handle huge amount of data

III. LITERATURE SURVEY

Author [1] survey introduced the lifecycle of phishing to clarify the important steps for antiphishing. This paper focuses on the technical methodologies, particularly machine learning based solutions for phishing website detection. Furthermore, the architecture of machine learning-based resolution shows the general components in the system. The details of each part inspire the development of high-performance phishing detection techniques. They reviewed diverse academic articles and sorted diverse data sources as shown. It is easy to start with published datasets that are standardized based on rules generated by security experts' experience. However, these datasets contain limited instances. Small datasets affect model performance in the training process, particularly for complex structured models such as multi-layer neural networks. In addition, they are relatively old, being collected approximately five years ago.

Author [2] Research proposes meta-heuristic based approach to protect the internet users from the web-phishing. It consists of three phases, the first phase uses a new proposed method for evaluating and ranking the features of URL, HTML and JavaScript code, text, images and domain name of the web page. The second phase extracts the effective subset of the ranked features that achieves the highest classification accuracy of the web-phishing. The third phase constructs the Random forest classifier training by data features of the extracted subset.

Author [3] they started with an overview of phishing attacks and several existing approaches to detect this attack. They further described the limitation of all the existing approaches and formulated our novel approach in phishing detection. Our approach used only nine features based on the lexical properties of URLs and produced an accuracy of 99.57. To clearly extract the features from URLs, we also described the feature extraction algorithms in brief. Later on, we provided the distribution.

IV. SYSTEM ARCHITECTURE

The system consists of major steps pre-processing, feature extraction, and classification. In the testing phase verification is done with pertained sample signatures.

• Preprocessing :The motivation behind the pre-processing stage is to make signature standards and prepared for include extraction. The pre-preprocessing stage basically includesnoise, resizing, Binarization, thinning, clutter removal, and normalization.

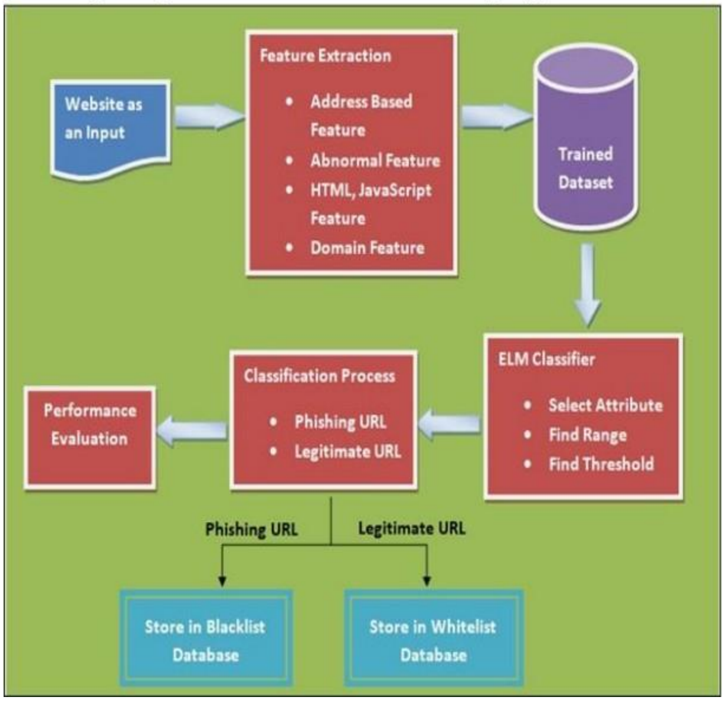


Fig. 2. System Architecture

• Feature Extraction : Features extraction is required when input information to an algorithm is excessively huge and repetitive. This excess information is then changed into the brief and fundamental arrangement of features. This technique is called feature extraction.

• Classification : Classification is the process where input information is sorted. Another piece of information when contributing to the framework tends to be effectively recognized as having a place with a specific class.

• Verification : In this step prepared classifier verify the test signature against a set of test sample signature it has pertained to during the classification stage. If the match is found over

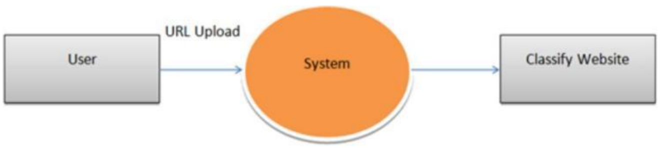


Fig. 3. Data Flow Diagram

a certain threshold, then the signature is considered original else it is considered forged.

V. IMPLEMENTATION

A. INTRODUCTION

The methodology involves building a training set. The training set is used for training a machine learning model, i.e., the classifier. Fig 4 shows the diagrammatic representation of the implementation.

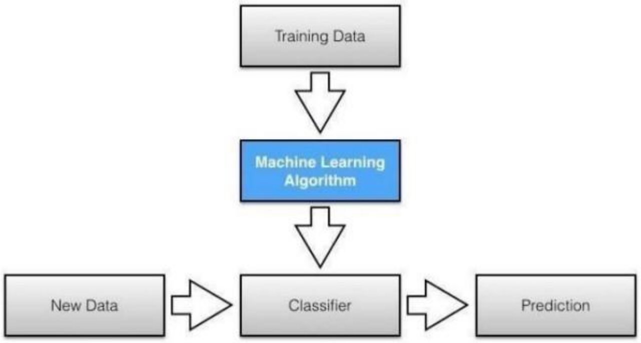


Fig. 4. Implementation

B. TECHNOLOGY USED

PYTHON

In technical terms, Python is an object-oriented, high-level programming language with integrated dynamic semantics primarily for web and app development. It is extremely attractive in the field of Rapid Application Development because it offers dynamic typing and dynamic binding options. Python is relatively simple, so it’s easy to learn since it requires a unique syntax that focuses on readability. Developers can read and translate Python code much easier than other languages. In turn, this reduces the cost of program maintenance and development because it allows teams to work collaboratively without significant language and experience barriers.

MACHINE LEARNING

Machine learning provides simplified and efficient methods for data analysis. It has indicated promising outcomes in real time classification problems recently. The key advantage of machine learning is the ability to create flexible models for specific tasks like phishing detection. Since phishing is a classification problem, Machine learning models can be used as a powerful tool. Machine learning models could adapt to changes quickly to identify patterns of fraudulent transactions that help to develop a learning-based identification system. Most of the machine learning models discussed here are classified as supervised machine learning, this is where an algorithm tries to learn a function that maps an input to an output based on example input-output pairs. It infers a function from labeled training data consisting of a set of training examples.There are many Machine Learning algorithms used for detecting phishing website.

PANDAS

Pandas is an open-source Python Library providing high performance data manipulation and analysis tool using its powerful data structures. The name Pandas is derived from the word Panel Data – an Econometrics from Multidimensional data. In 2008, developer Wes McKinney started developing pandas when in need of high performance, flexible tool for analysis of data. Prior to Pandas, Python was majorly used for data munging and preparation. It had very little contribution towards data analysis. Pandas solved this problem. Using Pandas, we can accomplish five typical steps in the processing and analysis of data, regardless of the origin of data — load, prepare, manipulate, model, and analyze. Python with Pandas is used in a wide range of fields including academic and commercial domains including finance, economics, Statistics, analytics, etc.

NUMPY

NumPy is a Python package. It stands for ’Numerical Python’. It is a library consisting of multidimensional array objects and a collection of routines for processing of array. Numeric, the ancestor of NumPy, was developed by Jim Hugunin. Another package Num array was also developed, having some additional functionalities. In 2005, Travis Oliphant created NumPy package by incorporating the features of Num array into Numeric package. There are many contributors to this open source project. Operations using NumPy Using NumPy, a developer can perform the following operations –

- Mathematical and logical operations on arrays.
- Fourier transforms and routines for shape manipulation.
- Operations related to linear algebra. NumPy has in-built functions for linear algebra and random number generation.

C. FLOWCHART OF THE SYSTEM

A flowchart is a diagram that depicts a process, system, or computer algorithm. It is a graphical representation of the steps that are to be performed in a system, it shows the steps in sequential order. It is used in presenting the flow of algorithms and to communicate complex processes in clear, easy-to understand diagrams. Figure 5 shows the flow of phishing detection systems using the machine learning process.

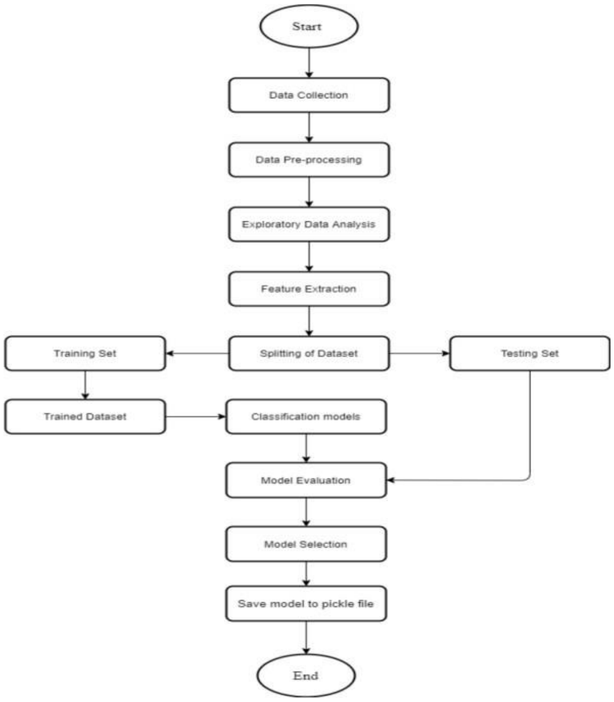


Fig. 5. Flowchart Of the Proposed System

Figure 6 shows the phishing detection web interface system. The user inputs a URL link and the website validates the format of the URL and then predicts if the link is phishing or legitimate.

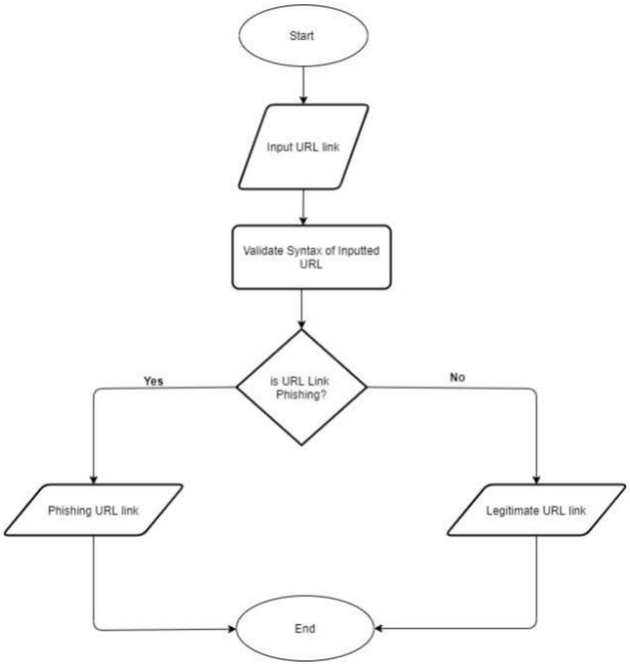


Fig. 6. Flowchart Of the Web Interface

VI. SOFTWARE & HARDWARE REQUIREMENTS

- Windows 7 or Higher
- Python 3.6.0 or Higher
- Visual Studio
- Dataset of Phishing Websites
- Django
- FLASK
- HTML
- 2 GB RAM (minimum)
- 100 GB HDD (minimum)
- Intel 1.66 GHZ Processor Pentium 4 (minimum)
- Internet Connectivity

VII. RESULT & SCREENSHOTS

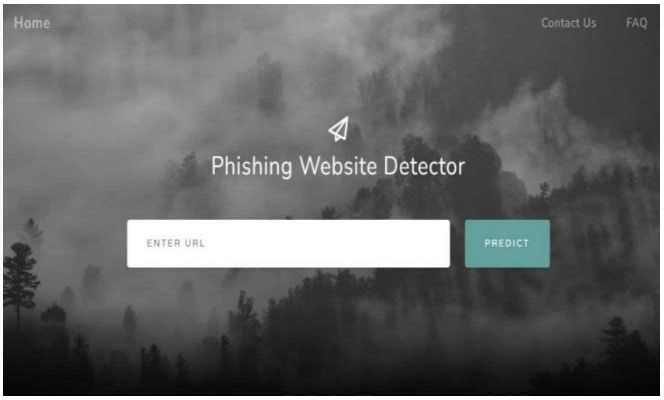
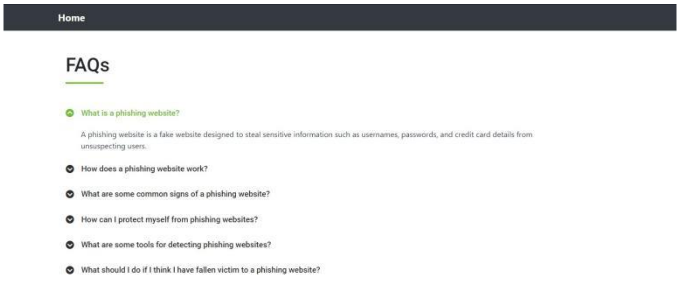


Fig. 7. HomePage



FAQs

- What is a phishing website?

  A phishing website is a fake website designed to steal sensitive information such as usernames, passwords, and credit card details from unsuspecting users.
- How does a phishing website work?
- What are some common signs of a phishing website?
- How can I protect myself from phishing websites?
- What are some tools for detecting phishing websites?
- What should I do if I think I have fallen victim to a phishing website?

Fig. 8. FAQ'S Page

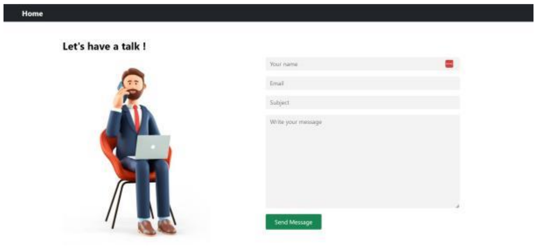
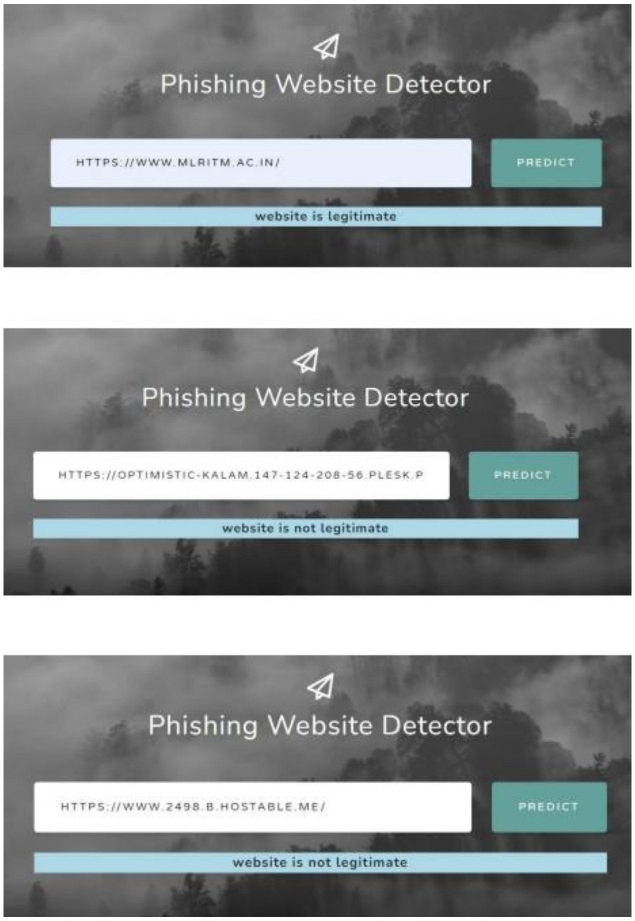


Fig. 9. Contact Us Page



HTTPS://WWW.MLRITM.AC.IN/

website is legitimate

HTTPS://OPTIMISTIC-KALAM.147-124-208-56.PLESK.P

website is not legitimate

HTTPS://WWW.2498.B.HOSTABLE.ME/

website is not legitimate

Fig. 10. Screenshots

VIII. CONCLUSION

The demonstration of phishing is turning into an advanced danger to this quickly developing universe of innovation. Today, every nation is focusing on cashless exchanges, business online, tickets that are paperless and so on to update with the growing world. Yet phishing is turning into an impediment to this advancement. Individuals are not feeling web is dependable now. It is conceivable to utilize AI to get information and assemble extraordinary information items. A lay person, completely unconscious of how to recognize a security danger shall never invite the danger of making money related exchanges on the web. Phishers are focusing on installment industry and cloud benefits the most.

The project means to investigate this region by indicating an utilization instance of recognizing phishing sites utilizing ML. It aimed to build a phishing detection mechanism using machine learning tools and techniques which is efficient, accurate and cost effective. The project was carried out in Anaconda IDE and was written in Python. The proposed method used four machine learning classifiers to achieve this and a comparative study of the four algorithms was made. A good accuracy score was also achieved.

The three algorithms used are Kernel Support Vector Machine, Decision Tree and Random Forest Classifier. All the three classifiers gave promising results with the best being Random Forest Classifier with an accuracy score of 95.90 %. The accuracy score might vary while using other datasets and other algorithms might provide better accuracy than random forest classifier. Random forest classifier is an ensemble classifier and hence the high accuracy.

IX. FUTURE SCOPE

Further work can be done to enhance the model by using ensembling models to get greater accuracy score. Ensemble methods is a ML technique that combines many base models to generate an optimal predictive model. Further reaching future work would be combining multiple classifiers, trained on different aspects of the same training set, into a single classifier that may provide a more robust prediction than any of the single classifiers on their own.

The project can also include other variants of phishing like smishing, vishing, etc. to complete the system. Looking even further out, the methodology needs to be evaluated on how it might handle collection growth. The collections will ideally grow incrementally over time so there will need to be a way to apply a classifier incrementally to the new data, but also potentially have this classifier receive feedback that might modify it over time.

Through this project, one can know a lot about phishing attacks and how to prevent them. This project can be taken further by creating a browser extension that can be installed on any web browser to detect phishing URL Links.

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