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# URL Hoaxing Detection using Machine Learning

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**ABSTRACT**

This research is all about detecting Phishing website. This project plays a cardinal role in detection of a phishing website and keeping user safe from fraudsters. Phishing is the most dangerous cyber-crime of the world with about 241,324 reported cases in 2020 and 96% of these attacks arrive by emails in form of some masked URL [1]. These attacks result in annual losses amounting to billions. This paper explores a Machine Learning model based on the Random Forest algorithm. It aims to predict whether a website is engaging in phishing activities or not by analyzing its URL and HTML content.

*Keywords— Random Forest Algorithm, Phishing Detection Using URL.*

## I. INTRODUCTION

Phishing is the most common form of cyber-attack all around the world. These attacks can affect a person or an organization by damaging their reputation, or by stealing their data, or direct monetary losses. These attacks are gaining momentum as they are easy to setup. It can be as easy as creating and hosting a fake website and luring users to give away their credentials. The best form of protection against these kinds of attacks is awareness and knowledge of such crimes because these kinds of attacks are very tempting. Attacks are evolving every second of time and attackers are changing their methods to lure users with different techniques. Phishing scams are done to gather data like credit card details, banking details, email passwords, or other personal sensitive data. All these attacks are successful when user clicks or visits the malicious website and enter their sensitive data.[2] There are some known differences between a phishing and a legitimate website and by looking for these differences these attacks can be prevented.

Phishing is carried out through various methods, including the following:

1. Email-to-Email: When an individual gathers an email containing sensitive information to forward it to the sender.
2. Website-to-Website: When someone is directed to a phishing website through a search engine or online advertisement.
3. Email-to-Website: When an individual receives an email containing a phishing link disguised as a legitimate website address.
4. Browser-to-Website: When someone mistypes a URL in the browser and is redirected to a phishing website with an address that closely resembles the legitimate URL..

All these attacks, despite being different from one another, have one thing in common, that is masked URL are used and other than that these URLs contain several suspicious flags like length of the URL, misspelled URL, too many special characters, too many sub domains etc. These URLs are very hard to distinguish from the regular ones. These URL leads to malicious and fake webpages which resembles an authentic website.

Most of the time there are some flags in these URLs for which user can look before clicking on them, but this task requires certain knowledge and can also be very tedious and time consuming. More importantly one can never be sure about the website by just looking for the flags in the URL. There is a more efficient method for distinguishing between Legitimate URL and Phishing URL and that is to look for the differences between the phishing webpage and legitimate webpage as they both are different from each other.[3] But, these methods are not easy to implement for a regular user.

In today's technically advanced world this problem can be addressed using Machine Learning. A Machine Learning algorithm called Random Forest is used to develop a model which takes URL of a website and predict whether that URL leads to a phishing website or a legitimate website. This model is trained using tokenized data (Byte Pair Encoding) of html pages of Legitimate and Phishing websites. When a URL is passed in the model, it grabs the HTML code and tokenize it. After tokenizing the html page, it compares it to the pre-learned data of both legitimate and phishing HTMLs and give the results accordingly.

The model is deployed in form of a website using flask where input URL will be taken from user and check whether the website is legitimate or not.

## II. METHODOLOGY

For training the model data has been collected from several phishing and legitimate websites HTML. Then collected data is tokenized using “Byte Pair Encoding” and derive a pattern using “TFIDF score” and memorize that pattern using “joblib”.

When a user enters a URL to check for its authenticity, the model grabs the html code of the following URL and tokenize it. Then “Random Forest” looks for a pattern in earlier memorized patterns and tokens of this HTML file and predict whether the URL is authentic or not.[4]

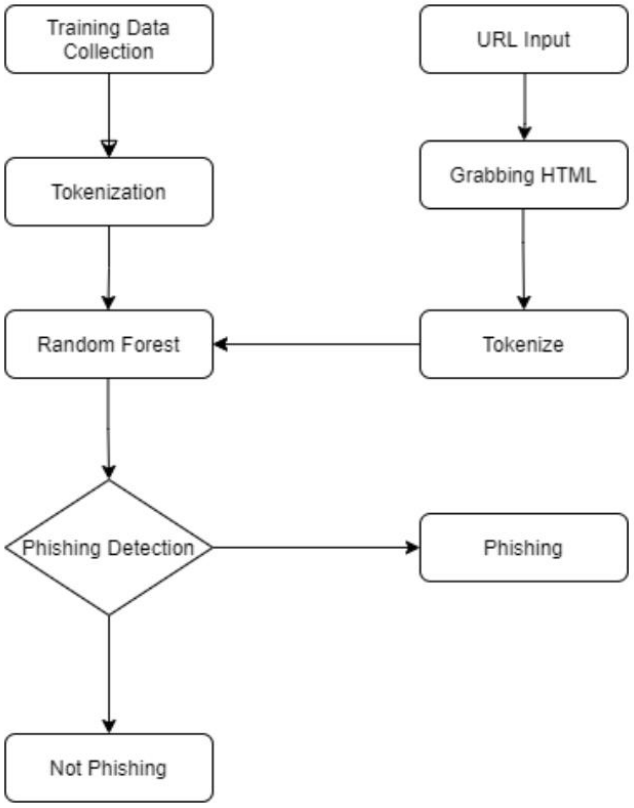



Fig. 1 Methodology

## III. RANDOM FOREST

Random forests, also called as random decision forests, are a type of ensemble learning technique utilized for classification, regression, and various other tasks. During training, they build numerous decision trees.

- In classification tasks, the random forest outputs the class chosen by the majority of trees.
- For regression tasks, it returns the mean or average prediction generated by the individual trees.

The Random Forest pseudocode:

1. Randomly select "k" features from a total of "m" features, where k is significantly less than m.
2. Among the "k" features, determine the optimal split point for the node "d".
3. Use the best split to divide the node into child nodes.
4. Repeat steps 1 to 3 until a certain number of nodes "i" has been reached.
5. Build the forest by repeating steps 1 to 4 "n" times to create "n" trees. In our implementation, classification is used to calculate entropy in the data. [5]

### A. *Formula for Variance / Mean Square Error*

$$\sum_{i=1}^{C} - f_i \log (f_i)$$

$f_i$ represents the frequency of label $i$ at a node.

$C$ is the number of unique labels [6]

## IV. RESULTS AND DISCUSSION

This model does a job of identifying authentic and phishing webpages. So, its efficiency is calculated on four parameters:

1. When a Legitimate website is provided and result is Legitimate.
2. When a Phishing website is provided and result is not Phishing.
3. When a Legitimate website is provided and result is Phishing.
4. When a Phishing website is provided and the result is Legitimate.

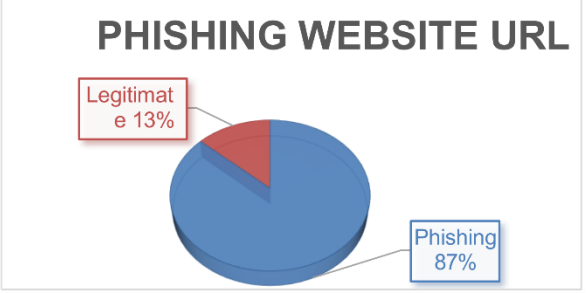
### A. Matrix

| Instance | Classifieds as Phishing | Classifieds as Legitimate |
|---|---|---|
| Phishing | 8776 | 48 |
| Legitimate | 1224 | 952 |
| Total | 10,000 | 1000 |

Table 1 : Confusion Matrix

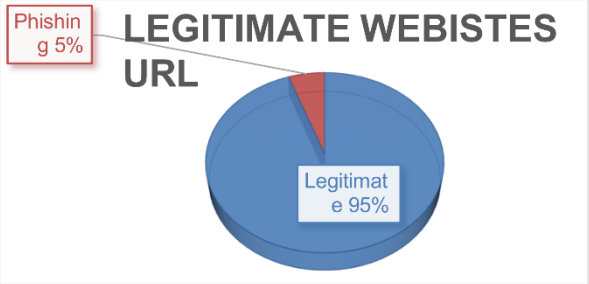
### B. Result when Phishing Websites URL are provided

The model is tested on over 10,000 phishing websites URL where the result was as follows:



C. Result when Legitimate Websites URL are provided

The model is tested on over 1000 legitimate website URL's where the result was as follows:




## V. CONCLUSION AND FUTURE SCOPE

It is always better to take some help of technology to provide accurate results. And from the results its concluded that the model has a successful chance of 87% in detecting a phishing website URL which is actually phishing. The model might tell a legitimate website as phishing but the possibility is as low as 5%. The purpose of the model is to solve a real-world problem that has grown enormously big in the last 2 decades. This research can be further extended in future for a commercially usable program or can be integrated with a browser like an extension. In near future with more training data the efficiency can be improved.

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