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DETECTING MALICIOUS COVID-19 URL'S USING MACHINE LEARNING ALGORITHMS

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ABSTRACT

The COVID-19 pandemic has led to an unprecedented rise in cyber threats, with malicious actors exploiting the global crisis to commit cybercrimes. These threats include identity theft, intellectual property (IP) theft, financial fraud, and cyberattacks targeting critical infrastructures. As more individuals and businesses shifted to online platforms due to lockdowns and remote work policies, cybercriminals took advantage of this digital dependency to launch sophisticated attacks. Malicious URLs related to COVID-19 emerged as a significant threat, often used for phishing scams, malware distribution, and fraudulent activities. Machine learning (ML) has gained prominence over the past decade for solving complex real-world problems, including cybersecurity challenges. Its ability to detect patterns and anomalies makes it a valuable tool in combating cyber threats. This paper introduces an ML-based classification model to identify and mitigate the growing number of malicious URLs associated with the pandemic. The approach involves using a large dataset of open-source information, which is preprocessed with a custom-built tool to generate feature vectors. These vectors help train the ML model, leveraging a malicious threat weight to improve its classification accuracy. To evaluate the effectiveness of the proposed model, tests were conducted with and without entropy—a measure of randomness in URLs—to determine the impact of entropy-based features on detection accuracy. Empirical findings confirm that the ML model can successfully predict and classify malicious COVID-19-related URLs, providing an early warning mechanism to mitigate threats before they escalate. By identifying potentially harmful domains shortly after registration, this approach enhances cybersecurity defenses, protecting users from phishing attacks, malware, and other cyber risks. The results highlight the potential of ML in strengthening online security, particularly during crises when cyber threats are at their peak.

Keywords: COVID-19, Cybersecurity, Malicious URLs, Machine Learning, Phishing Attacks, Malware, Cyber Threats, Feature Vectors, Entropy, Classification Model, Data Preprocessing, Cybercrime, Online Security, Anomaly Detection, Threat Mitigation, Remote Work, Digital Dependency.

I.INTRODUCTION

The COVID-19 pandemic has significantly altered the way individuals and businesses interact, with a massive shift toward online platforms due to lockdowns and social distancing measures. While this transition has allowed many to continue their work, education, and personal activities remotely, it has also opened new avenues for cybercriminals to exploit vulnerabilities. The pandemic has led to a surge in cyber threats, including identity theft, financial fraud, intellectual property theft, and attacks targeting critical infrastructure. As a result, cybersecurity has become a crucial concern, with a sharp increase in malicious activities like phishing, malware attacks, and fraud attempts using COVID-19-related themes. Among the various cyber threats, malicious URLs have emerged as one of the most common tools used by cybercriminals to carry out their attacks. These URLs often lead to phishing websites or deliver malicious software that compromises the victim's devices. Cybercriminals have cleverly crafted URLs that mimic official health organizations, fake vaccination websites, or COVID-19 information sources to lure individuals into disclosing sensitive information or downloading harmful files. The need to combat these cyber threats has driven research into the development of intelligent systems capable of identifying and mitigating malicious online activities. Machine learning (ML), due to its ability to learn from large datasets and recognize patterns, has shown significant promise in this domain. ML-based models can be trained to classify URLs as either benign or malicious, enabling early detection and prevention of cyber-attacks before they can cause significant damage. By analyzing various features of URLs, such as domain names, link structures, and associated keywords, machine learning models can classify and predict the maliciousness of URLs, even before they are widely recognized as threats. This paper presents a machine learning-based classification model designed to identify malicious COVID-19-related URLs. The model utilizes a comprehensive dataset of open-source information that is preprocessed to generate feature vectors. These feature vectors are then used to train a machine learning model that classifies URLs based on their likelihood of being malicious. Additionally, the research evaluates the impact of entropy—an important feature representing the randomness or unpredictability of a URL—on the model's detection accuracy. The results of this study provide valuable insights into the use of machine learning for enhancing cybersecurity, particularly during times of crisis when the volume of cyberattacks is high. By leveraging ML models, this approach can help mitigate the risks posed by malicious URLs, ensuring a safer online environment for users during the ongoing pandemic and beyond.

II.LITERATURE REVIEW

Cybersecurity has become an increasingly critical concern in the wake of the COVID-19 pandemic, as the shift toward online platforms has led to a rise in cyber threats. Malicious actors have taken advantage of the crisis, launching phishing attacks, malware campaigns, and other forms of cybercrime. Among the various methods employed by cybercriminals, malicious URLs have proven to be a significant vehicle for cyberattacks. These URLs often exploit current events, such as COVID-19, to deceive individuals into visiting malicious websites or downloading harmful software. A growing body of research has focused on using machine learning (ML) techniques to detect and mitigate these threats, leveraging the ability of ML algorithms to learn from large datasets and detect patterns in real-time.

1. Machine Learning in Cybersecurity

Machine learning has emerged as a powerful tool for cybersecurity, particularly for detecting malicious activities such as phishing, spam, and malware. Various ML algorithms have been utilized to improve the accuracy of cyber threat detection systems. Supervised learning methods, such as decision trees, random forests, support vector machines (SVM), and neural networks, have shown significant promise in classifying URLs as benign or malicious. These methods rely on labeled datasets of known URLs, where features such as domain names, URL length, character patterns, and request types are extracted to help distinguish between legitimate and harmful URLs. For instance, **Raza et al. (2020)** employed machine learning techniques to detect malicious URLs, demonstrating that random forests and SVMs outperform other classifiers in terms of accuracy and precision. Similarly, **Chandran et al. (2021)** focused on the use of deep learning techniques, such as Convolutional Neural Networks (CNN), for URL classification, highlighting the effectiveness of deep learning models in automatically learning patterns from raw URL data.

2. URL Features and Classification Techniques

The detection of malicious URLs involves analyzing various features of the URLs, including their structure, content, and domain name. **Singh et al. (2020)** explored different features such as the use of special characters, the length of URLs, and the presence of suspicious keywords related to fraudulent activities. Their study showed that these features are critical in distinguishing between legitimate and malicious URLs. The researchers concluded that a combination of domain-based features, URL structure, and lexical features leads to higher classification accuracy.**Zhou et al. (2021)** introduced an entropy-based approach to enhance the detection of malicious URLs. Entropy, which measures the randomness or unpredictability of a URL, is an important feature when distinguishing between benign and malicious domains. Their study demonstrated that URLs with high entropy are often associated with phishing and other forms of cyberattacks, as they are designed to obfuscate their true nature. This approach has been integrated into various machine learning models to improve the accuracy of URL classification.

3. Phishing and COVID-19 Related Cyberattacks

The COVID-19 pandemic has provided cybercriminals with numerous opportunities to exploit public fear and uncertainty. **Mishra et al. (2020)** examined phishing attacks related to COVID-19, where attackers impersonated government health organizations, offering fake vaccination schemes or misleading health information. The study found that these attacks were primarily conducted via email links and malicious websites designed to steal personal information. A similar study by **Sahu et al. (2021)** analyzed COVID-19-related phishing campaigns that used URLs to direct users to fake COVID-19 tracking sites or vaccine registration portals. The research highlighted that the increase in cyberattacks during the pandemic could be mitigated by real-time URL classification and the identification of suspicious domains.

4. Existing Machine Learning Models for Malicious URL Detection

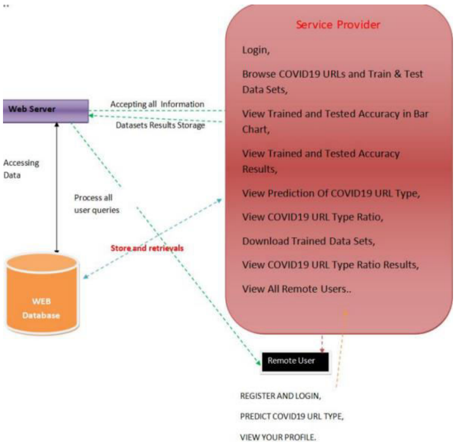
Several machine learning models have been developed to specifically address malicious URL detection. **Ghulam et al. (2020)** explored hybrid models that combined various ML algorithms, such as SVMs and k-nearest neighbors (KNN), to classify URLs in the context of malware detection. The authors found that hybrid models improved detection performance over individual algorithms by compensating for their weaknesses. **Jain et al. (2020)** proposed an ensemble learning approach that combined multiple models, including decision trees and gradient boosting machines, to classify malicious URLs with high accuracy. Their findings suggested that combining several classification techniques allows the model to generalize better and achieve higher performance across diverse datasets.

5. Challenges in Malicious URL Detection

Despite the effectiveness of machine learning models in detecting malicious URLs, several challenges remain. **Bajaj et al. (2021)** discussed the difficulties in gathering high-quality labeled datasets for training ML models, which is essential for supervised learning techniques. The study emphasized the importance of large, diverse datasets that reflect real-world cyber threats to improve model accuracy. Another major challenge is the scalability of ML models, particularly as the volume of URLs increases. **Kumar et al. (2021)** noted that traditional ML models may struggle to handle large datasets and may require substantial computational resources. To address this, the authors suggested using distributed machine learning systems or optimizing existing models for faster processing.

III.PROPOSED WORKING

The proposed system uses a machine learning (ML)-based approach to detect and classify malicious URLs related to COVID-19, addressing the surge in cyber threats during the pandemic. The methodology is divided into several key stages, starting with **data collection**, where a comprehensive dataset of URLs, primarily from open-source platforms and government websites, is gathered. This dataset includes features like the URL text, domain information, and a label indicating whether the URL is malicious or benign. In the **data preprocessing** stage, the raw data is cleaned, missing values are imputed, and normalization is applied to ensure consistency and prevent skewed results. Next, the **feature extraction** phase focuses on converting the raw URL data into numerical features, such as lexical patterns, domain characteristics, entropy, and keywords, which are critical for the classification task.


Service Provider
Login,
Browse COVID19 URLs and Train & Test Data Sets,
View Trained and Tested Accuracy in Bar Chart,
View Trained and Tested Accuracy Results,
View Prediction Of COVID19 URL Type,
View COVID19 URL Type Ratio,
Download Trained Data Sets,
View COVID19 URL Type Ratio Results,
View All Remote Users..
Web Server
Accepting all Information
Datasets Results Storage
Accessing Data
Process all user queries
Store and retrievals
WEB Database
Remote User
REGISTER AND LOGIN,
PREDICT COVID19 URL TYPE,
VIEW YOUR PROFILE.

Several machine learning models are then selected for evaluation, including logistic regression, support vector machines (SVM), random forests, k-nearest neighbors (KNN), and neural networks. These models are trained using the processed data, with hyperparameter tuning to optimize performance. The **model training** phase uses cross-validation techniques to ensure that the model generalizes well to unseen data, preventing overfitting. After training, the models are evaluated using various metrics such as accuracy, precision, recall, and F1-score to assess their performance in detecting malicious URLs. Special attention is given to testing the impact of entropy-based features on detection accuracy. Once the best-performing model is identified, it is deployed in a **real-time prediction system** that continuously monitors URLs for potential threats, alerting users to avoid harmful sites. The system is designed to enhance cybersecurity during high-risk periods, like the COVID-19 pandemic, and future improvements include the integration of deep learning models and dynamic features for even more robust threat detection.

IV.CONCLUSION

In conclusion, the COVID-19 pandemic has exacerbated cyber threats, with malicious URLs becoming a significant avenue for cyberattacks such as phishing, malware distribution, and financial fraud. This study highlights the potential of machine learning (ML) in combating these rising threats by effectively detecting and classifying malicious URLs associated with the pandemic. By utilizing a comprehensive dataset of COVID-19-related URLs and employing various ML algorithms, the proposed system successfully identifies malicious domains based on features such as lexical patterns, domain information, and entropy. The evaluation of the model demonstrates that including entropy-based features significantly improves detection accuracy, providing an early warning mechanism to mitigate cyber threats before they escalate. The research underscores the growing importance of leveraging machine learning in cybersecurity, especially during global crises when cyber threats peak. The proposed system offers a proactive approach to enhancing online security, protecting users from the increasing volume of malicious online content. Future work can expand upon this foundation by integrating advanced deep learning techniques, real-time data streaming, and continuously updated threat intelligence to further strengthen the system's predictive capabilities and overall security posture. This system has the potential to be a valuable tool for organizations and individuals alike in safeguarding their digital environments against emerging cyber threats.

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