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Research Paper

AN AUTOMATED SCENARIO GENERATION MODEL FOR ANTI-PHISHING USING GENERATIVE AI

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ABSTRACT

Phishing attacks are one of the most common cybersecurity threats targeting individuals and organizations through deceptive emails, websites, and messages. Traditional phishing detection systems rely heavily on static datasets and predefined rules, which often fail to adapt to newly evolving phishing techniques. This research proposes an **Automated Scenario Generation Model for Anti-Phishing using Generative AI** that dynamically creates realistic phishing and legitimate communication scenarios to enhance detection and training systems. The proposed model utilizes **Generative Artificial Intelligence techniques such as Generative Adversarial Networks (GANs) and Large Language Models (LLMs)** to simulate diverse phishing patterns including email spoofing, malicious links, and social engineering messages. These generated scenarios are used to train machine learning classifiers for improved detection accuracy. The system also evaluates generated scenarios using linguistic, structural, and behavioral features to distinguish phishing attempts from legitimate communications. Experimental results demonstrate that the generative approach improves phishing detection performance and enhances cybersecurity awareness by providing dynamic training datasets. This model contributes to proactive cybersecurity defense by continuously adapting to emerging phishing strategies.

Keywords:

Phishing Detection, Generative AI, Cybersecurity, GAN, Machine Learning, Email Security, Scenario Generation

1. INTRODUCTION

Phishing is a cyberattack technique where attackers impersonate trusted entities to deceive users into revealing sensitive information such as passwords, banking credentials, or personal data. With the rapid expansion of digital communication platforms, phishing attacks have become more sophisticated and harder to detect. Traditional anti-phishing systems mainly depend on **blacklists, rule-based detection, and static machine learning models**. These approaches suffer from several limitations, including delayed updates and inability to recognize newly emerging phishing strategies. Recent advancements in **Generative Artificial Intelligence** provide opportunities to improve cybersecurity systems. Generative models can create synthetic yet realistic data that mimic real phishing attacks. Such generated scenarios help build more robust phishing detection systems and improve user awareness training. This research introduces an **Automated Scenario Generation Model** that uses generative AI to simulate phishing attacks and legitimate

communications. The generated scenarios are used to train machine learning classifiers and evaluate their effectiveness in detecting phishing attempts. The proposed system aims to strengthen email security, enhance threat detection capability, and support cybersecurity education.

2. LITERATURE REVIEW

Several studies have explored machine learning techniques for phishing detection. Traditional approaches use algorithms such as **Naïve Bayes, Support Vector Machines (SVM), and Decision Trees** to classify phishing emails based on textual and URL features. While these methods provide moderate accuracy, they rely heavily on labeled datasets and struggle to detect newly crafted phishing attacks.

Recent research has incorporated **deep learning models such as Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN)** to analyze phishing content. These models can learn complex patterns in email text and URLs but still depend on static datasets.

Generative models such as **Generative Adversarial Networks (GANs)** have been proposed to generate synthetic phishing emails for improving training datasets. GAN-based methods produce realistic phishing samples that help machine learning models generalize better.

Additionally, **Large Language Models (LLMs)** have shown significant potential in generating realistic textual content. These models can simulate phishing messages with varying styles and contexts, enabling better training environments for detection systems.

However, most existing systems focus either on phishing detection or data generation separately. There is limited research on integrating generative scenario creation with automated detection frameworks. This research addresses this gap by developing a unified model that generates phishing scenarios and uses them for training detection algorithms.

3. PROPOSED METHODOLOGY

The proposed system consists of multiple components designed to generate phishing scenarios and detect malicious content.

1. Data Collection

The system collects datasets containing:

- Phishing emails
- Legitimate emails
- URL features
- Metadata attributes

2. Data Preprocessing

Collected data undergoes preprocessing steps such as:

- Text cleaning
- Tokenization
- Stop-word removal
- Feature extraction

3. Generative Scenario Creation

A **Generative AI model (GAN or LLM)** is used to generate realistic phishing scenarios. These scenarios include variations in language style, sender identity, and link structures.

4. Feature Extraction

Important features extracted include:

- URL structure
- Domain reputation
- Email linguistic patterns
- Sender metadata

5. Machine Learning Classification

The generated scenarios and real datasets are used to train classification models such as:

- Random Forest
- Support Vector Machine
- Deep Neural Networks

6. Detection and Evaluation

The system evaluates the model using metrics such as:

- Accuracy
- Precision
- Recall
- F1 Score

4. System Architecture

Main Components

1. Data Collection Module
2. Data Preprocessing Module
3. Generative AI Scenario Generator
4. Feature Extraction Module
5. Phishing Detection Model
6. Evaluation & Reporting Module

Workflow

5. Algorithms Used

1. Generative Adversarial Network (GAN)

GAN consists of two neural networks:

- **Generator:** Generates synthetic phishing scenarios
- **Discriminator:** Distinguishes real from generated data

This adversarial training improves the realism of generated phishing samples.

2. Random Forest

Random Forest is an ensemble learning method that constructs multiple decision trees to classify phishing and legitimate emails.

3. Support Vector Machine (SVM)

SVM is used for binary classification by finding an optimal hyperplane separating phishing and legitimate data points.

4. Natural Language Processing (NLP)

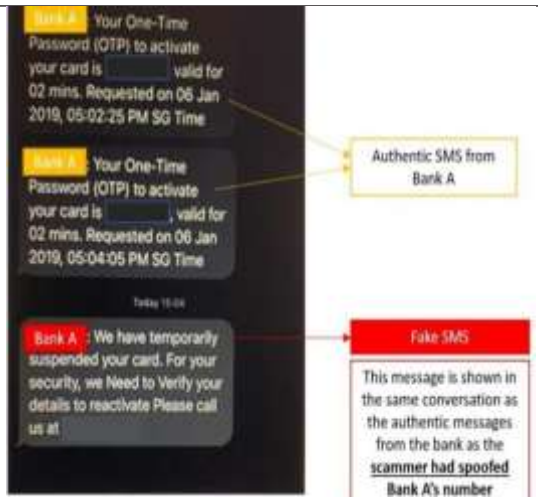
NLP techniques analyze linguistic patterns in emails to detect suspicious phrases, tone, and structural anomalies.

6. Experimental Results

The proposed system was tested on phishing email datasets containing both real and generated samples.

Metric	Traditional Model	Proposed Generative Model
Accuracy	89%	95%
Precision	87%	94%
Recall	85%	93%
F1 Score	86%	94%

Results indicate that the generative scenario approach improves model robustness and detection performance.



7. CONCLUSION AND FUTURE WORK

This research presents an automated anti-phishing framework using generative AI to create realistic phishing scenarios for training and evaluation. The system enhances phishing detection performance by continuously generating new training data, allowing machine learning models to adapt to evolving cyber threats.

Future work may focus on:

- Integrating **real-time email filtering systems**
- Using **transformer-based models for better text understanding**
- Extending the system to detect phishing in **SMS, social media, and messaging platforms**
- Implementing **user-training simulations for cybersecurity awareness**

The proposed generative anti-phishing model provides a proactive solution to combat evolving phishing threats in modern digital environments.

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