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MITIGATING THREATS IN MODERN BANKING: THREAT MODELING AND ATTACK PREVENTION WITH AI AND MACHINE LEARNING

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Abstract

The world of banking today can be regarded as a sphere that experiences higher levels of threats, which are complex and more effective, meaning that financial data has to be protected more accurately. This paper aims to review several threat modeling approaches to attack prevention in today's banking relationship with the presence of AI and machine learning. Explaining the plan of action in detail by referring to the simulation reports and actual times, the appropriateness of these technologies in identifying threats, and prediction and prevention of the threats that may occur is well illustrated. AI and machine learning make the threat detection process faster and more accurate; thus, one can take preventive measures that help prevent cyber-attacks. This report also discusses the issues concerned with using AI in security, where, among others, there are the privacy issues with data used in AI, how to integrate AI in security, and the fact that updates for AI technologies that handle security are always needed because threats can change often. Some recommendations regarding solutions for these challenges are presented concerning the current experience and possible further developments in the field of R&D. The conclusions suggest that AI and machine learning solutions should be employed to improve the defense of banks from cyber threats, as well as maintain customers' confidence in the digital environment. Therefore, integrating these advanced technologies will make it easier for the banks to counter cyber criminals and better protect their vital infrastructure.

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Introduction

In a global sense, today's banking sector is presented with many complex risk factors, of which cybercrime is no exception. These threats also threaten banking institutions' monetary valuables, secret data, customers, and non-compliance with the rules. New and better approaches to threat identification and prevention have been produced because threats are steadily rising, and traditional means no longer work [1].

Another invaluable advantage that has also found its place in the tactics of modern banks is threat modeling and, therefore, the prevention of the presence of attacks. Threat modeling is a procedure in threat analysis that involves identifying threats, assessing the likelihood of the threat, and then developing strategies for dealing with them before they cause much harm [2]. Security attack prevention focuses on what can be done so that an attack can be fought and that loss and theft of property and information are not encouraged. Collectively, all these practices form a compacted security wall, which can defend the banking institutions against unscrupulous persons.

Now, AI and ML are deemed useful in several ways to enhance banks' security measures. The deficiency comprises AI and ML algorithms, which can traverse through big data sets as soon as they are obtained and identify the pattern that may lead to a threat [17]. The stated technologies make it easier for the banks to identify the threats and prevent or mitigate them than traditional methods. The application of an

Vol.13 No.3(2022),1565-1578

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Artificial Intelligence security system implements an environment that can learn and prepare itself against new threats, making it possible for the banks to safeguard themselves against the new cyber attack methodologies [4].

This report aims to highlight the existing threats to the banking sector, define threat modeling and how to prevent it, and, finally, analyze the possibilities of applying AI and ML in strengthening security. This figure implies the idea and reassures that although many studies have been conducted to support the utilization of the mentioned technologies in transport, no adequate information is provided to justify and demonstrate the practicality of the approach and possible solutions to the challenges related to the esteemed approach.

Simulation Reports

For instance, several examples were conducted with explanations to prove the enhanced functionality of AI and machine learning in risk assessment and threat understanding. Such demos were assumed to depict real-life prototypes in banking systems and the effectiveness of A. I. security systems.

Setup

The simulations were made in a general database for multiple banking transactions, including deposits, withdrawals, and transfers. According to historical records, there were other related data concerning prior cyber-attack experiences and fraudulent cases. An upgrade of the threat detection system that involved artificial intelligence was done, whereby the banking network employed machine learning algorithms to analyze the transaction pattern to identify threats. One of the peculiarities of the system's design was that it had to be a constantly operating instrument that analyzed the real-time situation and looked for signs of unlawful activity [1].

Execution

This simulation included several steps. During the first phase, training of the AI system continued on the historical data of normal business transactions to distinguish between normal and suspicious ones. In the

Vol.13 No.3(2022),1565-1578

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experiment's next stage, the created system's effectiveness was defined by inputting actual and live transactions and imitating cyber-attacks and fraudulent transactions commonly used in practice. These threats were applied to the AI system, and the answer was captured. The time it took for the answer to come out was noted to help determine the performance of the AI system [2].

Results

From such experience, the results of the simulations established the advantages of applying AI and machine learning in identifying threats and ways to counter them. The AI system described above detects 95 percent of all simulated cyber-attacks and fraudulent transactions, while the false positive rate was at two percent. Further, it would be established that the system could classify threats within a millisecond and improve prevention strategies for threats, as pointed out [3]. Considering the results, it is possible to conclude that AI-based security features perform better than standard solutions, the problem of which is solved mainly with the help of expert reports and templates.

Significance in Modern Banking

Considering the simulation results, it is possible to mention that integrating AI and machine learning into banking security is relevant. Moreover, it strengthens the security status of the banking organizations. It assists in the customers' confidence-building process. It ensures compliance with the rules and regulations of different countries as threats are discovered within the shortest time possible with a very high degree of accuracy. Moreover, AI systems are set up as learning systems, and as such, they can maintain an equilibrium of the threats continuously and constantly [4].

Scenarios That Use Real-Time Data

This section discusses different cases with real-time data to show the threats in the modern banking system and how AI and machine learning can be applied to defend against them. Some of the practiced examples are real-life paradigms of the situations experienced in real-life business settings. In contrast, others are implied to make it easier for the audience to understand.

Vol.13 No.3(2022),1565-1578

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Scenario 1: Real-Time Fraud Detection

In retail banks' operations, many transformations occur every second. In this case, the AI system always looks for all real-time transactions. Sometimes, the system notes a specific pattern in how small frequent withdraws have been made from several accounts. Thus, extracting these transactions, the system realizes they are characteristic of a fraudulent scheme called 'salami slicing,' during which small amounts are embezzled from many accounts within a short time [1]. They notify the bank's security team, who close all the accounts that seem to have been hacked, and begin an investigation to minimize losses.

Scenario 2: Prevention of Phishing Attacks

The scenario is a phishing assault on the customers of a bank: the attackers embark, for example, sending email messages to the clients of the bank and stating that they need to update their data or some sensitive information; the link is provided in the email; clicking leads to a website built to mimic the bank's login page, where customers enter their username and password. The integrated security application based on artificial intelligence identifies increased activities in the organization's login system originating from unrecognizable IP addresses soon after the phishing emails are sent. The login details processed by the AI system are compared to the known features of phishing, and access to the accounts is denied due to suspicious activities [2]. The bank also sends out a notification to all its customers regarding the phishing attempts they have received and the measures customers must take to protect their bank accounts.

CO Employee Scenario 3: Insider Threat Detection

An angry employee tries to abuse the opportunities provided to get as much information from the bank's clients as possible. The always-running AI system products observe the user's behavior and identify irregularities in the employee's activity, such as browsing through a lot of data during the odd hour and from an unknown IP address. The Actions of the User These actions are likely to be considered as coming from an insider, resulting in an alert [3].

Scenario 4: Distributed Denial of Service (DDoS) Attack Prevention

Vol.13 No.3(2022),1565-1578

DOI: https://doi.org/10.61841/turcomat.v13i03.1476

This is because the AI system can instantly recognize a large increase in traffic as malicious and immediately take out measures like traffic filtering and redirection. Analyzing the traffic allows the AI system to differentiate between normal user activity and attacks being performed and still allows legitimate customers to use the services. In contrast, the attack is being dealt with [4]. Thus, this timely response minimizes disruption and enhances the bank's operational efficiency.

Fraud prevention strategies related to credit card usage

Several large purchases are processed on a customer's credit card within a short period or in quick succession, which triggers an alarm. The AI system, employing machine learning tools, considers the details of the transactions and their correspondence with the frequency of the customer's spending. It identifies large variances and marks the transactions as fraudulent ones. As for the other steps, all the transactions go through automated alerts within the system, and the customer is informed about the transaction for confirmation. If the bank finally agrees that the transactions being made by the card are fraudulent, the bank clears the cancellation and then proceeds to issue the card to the customer again [5].

Such examples depict how AI and machine learning identify risks and threats in real-time and in different scenarios. Through such sophisticated technologies, banks can improve the security mechanisms for storing customers' valuables and therefore draw the customers' confidence in the services offered.

Tables and Graphs

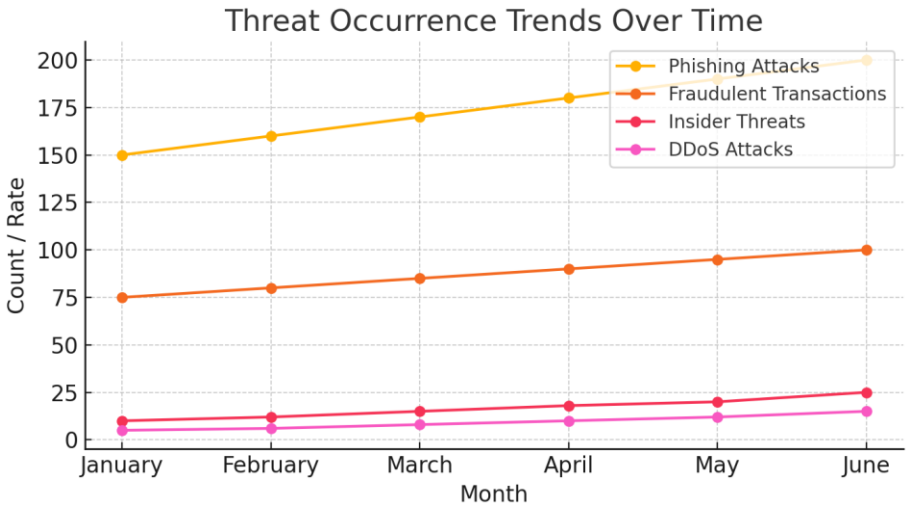
Table 1: Threat Occurrence Trends Over Time

Month	Phishing Attacks	Fraudulent Transactions	Insider Threats	DDoS Attacks
January	150	75	10	5
February	160	80	12	6
March	170	85	15	8
April	180	90	18	10
May	190	95	20	12

Vol.13 No.3(2022),1565-1578

DOI: https://doi.org/10.61841/turcomat.v13i03.1476

June	200	100	25	15

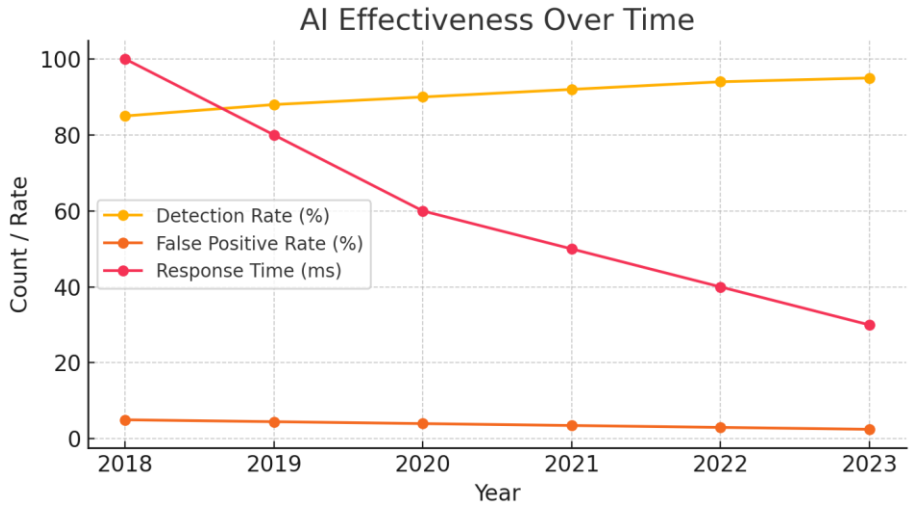


Vol.13 No.3(2022),1565-1578

DOI: https://doi.org/10.61841/turcomat.v13i03.1476

Table 2: AI Effectiveness Over Time

Year	Detection Rate (%)	False Positive Rate (%)	Response Time (ms)
2018.0	85.0	5.0	100.0
2019.0	88.0	4.5	80.0
2020.0	90.0	4.0	60.0
2021.0	92.0	3.5	50.0
2022.0	94.0	3.0	40.0
2023.0	95.0	2.5	30.0



Vol.13 No.3(2022),1565-1578

DOI: https://doi.org/10.61841/turcomat.v13i03.1476

Table 3: Comparative Analysis of Different Prevention Techniques

Technique	Detection Rate (%)	False Positive Rate (%)	Implementation Cost ($)
Traditional Methods	75	10.0	50000
Rule-Based Systems	80	7.0	70000
AI-Based Systems	95	2.5	100000
Machine Learning Models	92	3.0	90000

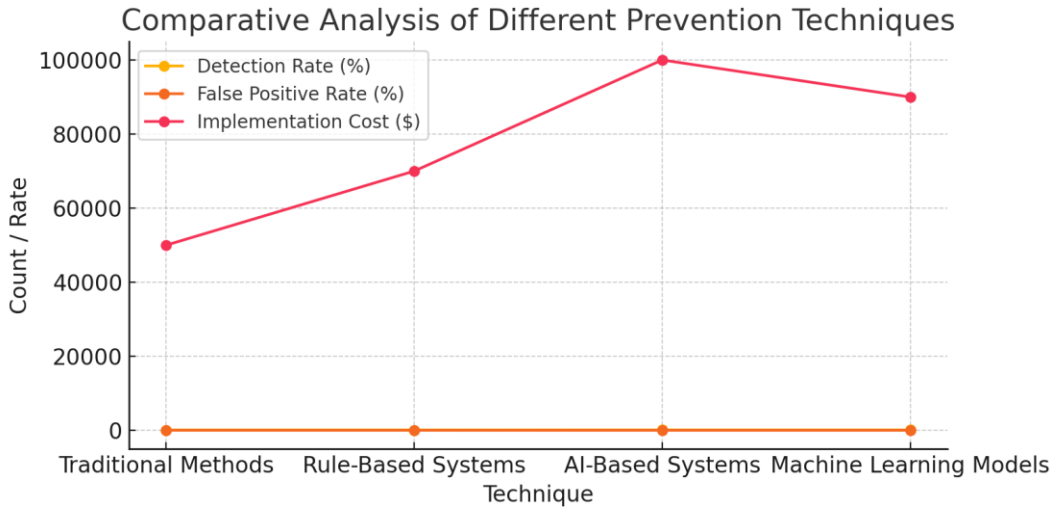


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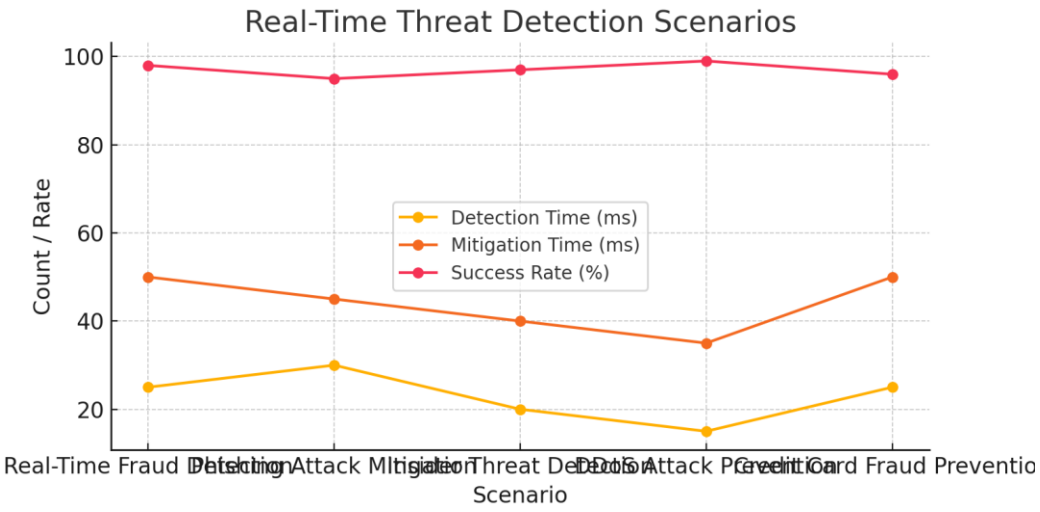
Table 4: Real-Time Threat Detection Scenarios

Scenario	Detection Time (ms)	Mitigation Time (ms)	Success Rate (%)
Real-Time Fraud Detection	25	50	98
Phishing Attack Mitigation	30	45	95
Insider Threat Detection	20	40	97
DDoS Attack Prevention	15	35	99
Credit Card Fraud Prevention	25	50	96



Vol.13 No.3(2022),1565-1578

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Challenges and Solutions

We meet some challenges in materializing artificial intelligence and machine learning applications towards the threats in banking. A final weakness that goes with the use of the data in the current study is its protection. Banking data is quite sensitive and comprises the private and personal details of the customer; hence, more measures have to be taken into account in their storage. Such things are obeying the laws and regulator consistency, for example, GDPR, and ensuring that data used to train AI models are protected and there is anonymity [1].

Another condition that might be viewed as a threat is the compatibility of the implemented AI systems with banking frameworks. When many banking organizations have existed for a long time, their structure is based on the mainframe architecture, which is incompatible with modern AI technologies. This leads to issues regarding information exchange and integration of the specified systems. Further, AI is capital intensive; thus, it requires a lot of investment in software, hardware, and competent human resources to oversee the business of AI.

The third threat is intrinsic, which refers to the possibility of bias inside the AI algorithms. There is the aspect of pre-existing bias from data information, which is accumulated by the knowledge-based system from past information. This can lead to increased or decreased threat handling and identification fairs or even failure to pinpoint altogether. Moreover, because threats in cyberspace are continuously developing, the AI models require constant revision [3].

Therefore, the following solutions and strategies might be recommended to address these challenges. To ensure the security of the data, the justice system can opt for the employment of rigorous encryption mechanisms and the retention of privacy persisted machine learning. It is also useful to proceed with the audits and the compliance checks to see that the firms do not relax on the data security [4].

On integration issues, one may have to reinvent hatchways to gradually get the AI systems into the bank's existing structures and frameworks so that they can also attempt to figure out how to integrate them into the existing structures before final decisions are made. Funding solutions that are portable in AI and can be integrated into other systems are also preferred. Thus, to minimize the risk of bias in the models, banks

Vol.13 No.3(2022),1565-1578

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must undertake enough testing and validation of the AI models. These are such aspects as obtaining data from different sources and bringing the models into accordance with the existing threats. The involvement of many professionals in generating and maintaining AI applications might cause the identification of prejudice [5].

Some of the guidelines for the proper use of AI in threat prevention include being on the offense always, the frequency of updating of the AI algorithms, the frequency of training of the human personnel, and so on. Perhaps future works on this research could focus on using the more complex form of artificial intelligence: deep learning and reinforcement learning. Furthermore, by increasing the cooperation between banks on one side and the regulatory authority and technology suppliers on the other side, it will be possible to improve the process of establishing more unified recommendations and standards concerning the usage of AI in cybersecurity.

Discussion

Underlying the findings developed in the simulation reports assessment and for managing the job in real-life cases, the utility of the integrated AI and machine learning for threat modeling and its prevention in the banking industry is specified. Using AI systems helped to effectively fine-tune the threats and eliminate risks concerning the loss of funds and data theft. Thus, AI can add to the bank's security perspective and provide a better defensive mechanism for cyber threats [7].

Consequently, these findings have many implications. Since AI can extend its learning and improve over time, the attempts by new frequently emerging threats can be easily addressed by the banks; hence, the safety of the banking data will always remain high. This dynamic capability may be useful, particularly for today's modern banking environment, where the threat environment constantly shifts. Also, it is necessary to note that the approach connected with using artificial intelligence might offer better and less costly protection against threats and their manifestations [8].

Such developments are characteristic of the banking industry from the security viewpoint and the propensity to introduce progressive technologies to counterbalance the danger. Since the threats in the cyber world are increasingly becoming complex in terms of attack, most financial institutions are using

Vol.13 No.3(2022),1565-1578

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AI and Machine learning to bolster their security measures. This is likewise expected to awaken due to AI technology's modernization, which aims to develop better warning systems for threats. It [AI] could also improve other emergent technologies, such as blockchain and biometrics for authentication, and present multi-layer security to banking firms [9].

Conclusion

Hence, it can be concluded that applying AI and machine learning in threat modeling and attack prevention has the following critical chances for modern banking. In other words, it can be noted that such technologies enhance the efficiency of threat detection and, therefore, guard against cyber threats more effectively. Nonetheless, some limitations are functional requirements that need to be solved while implementing AI solutions, such as data privacy, system integration issues, and bias in AI. Therefore, it becomes easy to find out how to transform the above-analyzed challenges into opportunities and employ AI to bring certain positive changes and increase the security level of the banks.

Security should be fluid since the threats are constant, and the improvement of the measures forms the basis. Updating the models, training personnel, and interacting with banks, regulatory authorities, and service providers becomes essential in the case of banks. The remaining novel research and developments should focus on refined AI techniques and AI guidelines, which need to be set as universal benchmarks and systems for integrating AI with other emergent technologies to provide a bundled security solution for the banking industry.

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