Chapter 6

Feature Engineering and Computer Vision for Cybersecurity:
A Brief State-of-the-Art

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ABSTRACT

In cybersecurity, the fusion of feature engineering and computer vision presents a promising frontier. This study delves into their symbiotic relationship, highlighting their combined potential in bolstering cybersecurity measures. By examining tailored feature engineering techniques for intrusion detection, malware analysis, access control, and threat intelligence, this work sheds light on the transformative impact of visual data analysis on cybersecurity strategies. Harnessing feature engineering pipelines alongside computer vision algorithms unlocks novel avenues for threat detection, incident response, and risk mitigation. However, challenges such as overfitting, adversarial attacks, and ethical concerns necessitate ongoing research and innovation. This chapter lays the groundwork for future advancements in feature engineering for computer vision in cybersecurity, paving the way for more robust and resilient security solutions.

INTRODUCTION

The proliferation of digital assets and interconnected systems, organizations face an ever-growing array of cyber threats ranging from malware, phishing attacks to sophisticated cyber-physical intrusions and data breach each year, which have been forecasted to USD 12 million of cost for 2026 (IBM, 2023). Traditional rule-based approaches often fall short in adequately addressing these dynamic threats, necessitating a paradigm shift towards data-driven methodologies (Jothibasu, 2023).. Thus, Feature engineering and computer vision are two fundamental concepts in data analysis and image processing, each playing crucial roles in various domains. Firstly, Feature Engineering (F.E.) involves the process of selecting, transforming, and creating meaningful features from raw data to facilitate machine learning algorithms' performance (Sriram, 2020) (Jha, 2023). These features serve as essential descriptors that encapsulate relevant information, enabling algorithms to discern patterns and make accurate predictions. On the other hand, computer vision encompasses the field of artificial intelligence and computer science dedicated to enabling machines to interpret and understand visual information from digital images or videos (Alosaimi, 2023) (Jothibasu, 2023).

Furthermore, the amalgamation of feature engineering and computer vision presents a potent solution to combat evolving threats and vulnerabilities. One compelling application lies in anomaly detection, where the detection of suspicious activities or intrusions within a network is paramount (Gibert, 2022). By harnessing computer vision techniques to analyze network traffic or surveillance footage, coupled with adept feature engineering, cybersecurity professionals can identify aberrant patterns indicative of potential security breaches or malicious activities (Duong, 2023).

In this work, a brief state-of-the-art is realized about feature engineering and computer vision in cybersecurity.

The rest of the document is organized as follows. In section 2, studies that explore FE and CV for cybersecurity issues are discussed followed by problem statement and research methodology respectively in section 2 and 3. In section 4, we detailed the background related to CV and FE. Then, we presented the literature analysis in section 5. Finally, we mentioned open issues in section 6 and conclude with perspectives.

1. RELATED INVESTIGATIONS

Machine Learning (ML) and Deep Learning (DL) techniques have been extensively explored and applied in the domain of cybersecurity to address a wide array of challenges. Notably, (Jha, 2023) surveyed the potential of integrating ML and Natural

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