

Abstract

In the recent development of the Internet of Things (IoT), security challenges, particularly concerning BotNet threats, have become increasingly critical. The complexity and dynamics of BotNets make detecting and mitigating these threats difficult and inefficient. This study aims to compare the effectiveness of three ensemble learning techniques: Bagging, Boosting, and Stacking, in enhancing BotNet detection in IoT environments. Using the BoTNeTIoT-L01 dataset, the study evaluates each technique based on accuracy, precision, recall, and F1-Score metrics. The results show that Bagging and Stacking achieved a perfect accuracy of 1.00 across all evaluation metrics, making them the most effective methods for BotNet detection. Meanwhile, Boosting showed varying results with an initial accuracy of 0.75 before tuning, improving to 0.92 after parameter adjustments. This research reveals that Bagging and Stacking are the most efficient techniques for improving IoT security, while Boosting requires further tuning to achieve optimal performance. These findings provide a significant contribution to the development of more robust cybersecurity strategies to protect IoT networks from increasingly complex BotNet threats.

Keywords: Ensemble Learning Techniques, BotNet Identification, Internet of Things, Comparative Analysis, Bagging, Boosting, Stacking.