**Faculty of Engineering and Technology (FE****T)**

**Sri Sri University**

**Cuttack Odisha India Pin-754006**

**B.Tech in Cybersecurity & Cyberdefense**

**Major Project Report**

**Project Title: SIEM IMPLEMENTATION AND ITS USE CASES**

**Group Number: 1**

**Department: FACULTY OF ENGINEERING AND TECHNOLOGY**

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# Certificate of the Guide

This is to certify that the project titled "SIEM IMPLEMENTATION AND ITS USE CASES” submitted by the following students:

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of the **Faculty of Engineering and Technology** has been carried out under my guidance in partial fulfillment of the requirements for the award of the degree.  
  
To the best of my knowledge, this work has not been submitted to any other university or institution for the award of any degree or diploma.

INTERNAL EXTERNAL

Guide Name: Dr Tishya Manna Guide Name: Mr. Paramveer Singh

Designation: Assistant Professor Designation: Cybersecurity Engineer

Institution: SRI SRI UNIVERSITY Institution: Cyber Dojo

(Signature) (Signature)

# Student Declaration

We hereby declare that the project work entitled "SIEM IMPLEMENTATION AND ITS USE CASES” submitted to Faculty of Engineering and Technology, Sri Sri University Cuttack Odisha, is a record of original work carried out by us under the guidance of Dr Tishya Manna.  
  
This work has not been submitted anywhere else for any other degree or diploma.

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Date:\_\_\_15.04.2025\_\_\_\_\_\_\_   
Place:\_\_\_\_\_SRI SRI UNIVERSITY\_\_\_\_\_

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We are also thankful to the faculty and staff of the Faculty of Engineering and Technology Sri Sri University Cuttack for their assistance and for providing the necessary facilities to carry out our work.

Our heartfelt thanks to our families and friends for their moral support and motivation during the project development.

Finally, we thank each other as a team for the hard work and collaboration that made this project a success.

Students Signatures:



**Table of Contents**

1. **Cover Page**
2. **Guide Certificate**
3. **Student Declaration**
4. **Acknowledgement**
5. **List of Abbreviations**
6. **Introduction**
7. **Objectives & Scope**
8. **Problem Statement**
9. **Motivation**
10. **Literature Review**
11. **Proposed Solution**
12. **System Design / Workflow**
13. **Technical Details**
14. **Implementation**
15. **Testing (unit, integration, system, etc.) & Results and Analysis**
16. **Cost Analysis**
17. **Societal & Industry Impact**
18. **Conclusion & Future Scope**
19. **References**
20. **Appendix (if any)**
21. **Code (if any)**
22. **LIST OF ABBREVIATIONS**

|  |  |  |
| --- | --- | --- |
| Sr. No. | Abbreviations | Expansion |
|  | SIEM | Security Information and Event Management |
|  | EDR | Endpoint Detection and Response |
|  | FIM | File Integrity Monitoring |
|  | SSH | Secure Shell |
|  | SME | Small to Medium-sized Enterprise |

**1. INTRODUCTION**

**1.1 Background**In today's digital era, cybersecurity threats are not only becoming more common, but also more complex and damaging. From large corporations to small businesses, no organization is entirely safe from the risk of data breaches, financial loss, or the breakdown of customer trust. As technology evolves, so do the tactics used by cybercriminals. This makes it essential for businesses to adopt proactive and intelligent security strategies. One powerful tool in this area is a Security Information and Event Management (SIEM) system. SIEM solutions help organizations monitor their digital environments by collecting, analyzing, and correlating data from various sources like logs, endpoints, and network devices. These systems play a key role in identifying suspicious behavior and allowing real-time responses to potential threats.

**1.2 Objective**The main objective of this project was to implement and configure a functional SIEM system in a lab environment that mimics the cybersecurity needs of a small business. The focus was on detecting and responding to common types of cyber threats such as brute-force attacks, unauthorized access attempts, file integrity issues, and endpoint security breaches. Through this project, I aimed to understand how integrated security tools work together to strengthen an organization’s defense system. More importantly, this hands-on experience allowed me to explore how SIEM technology can provide real-time insights into potential threats and support a more responsive and informed cybersecurity strategy.

**1.3 Scope**  
This project was carried out in a controlled lab setup that represents a small business infrastructure. By keeping the environment manageable and focused, I was able to simulate real-world cyberattacks and monitor how the system responds. This approach made it easier to test different scenarios, observe how data is processed, and make adjustments in real-time. Although the environment was limited in scale, it effectively demonstrated the core functionalities of a fully operational SIEM system. It provided a solid foundation for understanding both the technical and strategic aspects of modern cybersecurity.

**1.4 System Name**

SIEM System for Small Businesses .

**1.5 System Description**The SIEM system developed for this project was built using various components that work together to offer comprehensive security monitoring. The core elements included a firewall, the Wazuh dashboard, agents, and a central management server. Each part played a specific role:

* Wazuh agents were installed on endpoints to collect system data.
* The Wazuh manager acted as the brain of the system, analyzing and correlating data.
* The dashboard provided a user-friendly interface to monitor alerts and incidents.  
  Together, these tools created a dynamic system capable of identifying suspicious activity and providing timely alerts to support security teams in taking action.

**1.6 Aim of the System**The aim of this project was to build a system that could monitor, detect, and respond to cybersecurity threats in real-time, within a safe and controlled lab environment. By leveraging data analysis and advanced threat detection techniques, the system was designed to reflect how real-world organizations can use SIEM tools to protect their digital assets. This project not only enhanced my technical skills but also gave me practical experience in understanding how cybersecurity solutions are applied in professional settings. It serves as a steppingstone toward more complex and scalable security infrastructures in the future.

**2. Objectives & Scope**

The core objective of this project was to **implement and configure a Security Information and Event Management (SIEM) system** specifically designed for small business environments, within a controlled lab setting. The overarching goal was to simulate real-world cyber threat scenarios and analyze how an integrated SIEM framework can effectively detect, analyze, and respond to those threats.

The following were the key objectives pursued in the course of this project:

1. **To understand and deploy a working SIEM framework** using open-source tools like **Wazuh**, capable of real-time monitoring and incident response.
2. **To integrate various components** such as Wazuh manager, dashboard, agents, and a firewall system to ensure a comprehensive monitoring and analysis capability.
3. **To simulate and detect common cyber threats** including brute-force attacks, file integrity violations, USB-based endpoint intrusions, and unauthorized access attempts, among others.
4. **To develop and test multiple security use cases** that would provide measurable insights into the effectiveness of the SIEM system.
5. **To familiarize with log collection, rule creation, alert generation, and threat correlation techniques**, which are essential functions in any security operation center (SOC).
6. **To document and analyze the results of the SIEM system’s response** to security incidents and identify areas of improvement and optimization.
7. **To propose enhancements and future integrations** (e.g., with the ELK stack) that can further expand the functionality and intelligence of the security framework.

These objectives were not only technically driven but also educational in nature. They aimed at providing hands-on learning experience for understanding how cybersecurity systems function in enterprise and SME environments.

**Scope**

The scope of this project was intentionally kept **confined to a simulated lab environment** that represents the digital infrastructure of a small business.

This controlled setting allowed the project to be both **comprehensive and focused**, enabling detailed configuration, testing, and observation of the SIEM system’s behavior.

Key elements included in the scope were:

* **Implementation of the Wazuh SIEM stack** including Wazuh Indexer, Manager, Dashboard, and Agents.
* **Design and execution of specific use cases** like Brute Force Attack Detection, File Integrity Monitoring (FIM), USB device monitoring through Endpoint Detection and Response (EDR), and real-time alert generation.
* **Configuration of secure communication protocols** between agents, server, and dashboard using encrypted channels (AES and TLS).
* **Testing of the system's performance and response** using a structured series of cybersecurity scenarios in a sandboxed setting.

While the scope was comprehensive in terms of technical implementation, it was **limited by certain constraints** such as:

* The system was not tested in a live business network due to security and privacy implications.
* The infrastructure was based on a small number of virtual machines and endpoints, thus not representing the scale of large enterprise environments.
* Advanced threat detection features such as behavioral analytics and machine learning were not fully explored but marked for future scope.

The **deliberate focus on small business needs** stems from the increasing frequency with which SMEs are being targeted in cyberattacks, often due to

their limited investment in cybersecurity infrastructure. This project, therefore, offers a **replicable and cost-effective framework** that can be scaled or modified as per specific organizational requirements.

By the end of this project, the SIEM system demonstrated **effective functionality in a lab environment**, with potential applications in real-world SMEs where budget-friendly yet robust security systems are in high demand. The foundational work done here sets the stage for further enhancements and industry-level deployments.

1. Problem Statement

Implement a SIEM solution in a lab environment or for a small business. Configure log sources, correlation rules, and incident response procedures. Design and implement specific SIEM use cases using WAZUH to detect and respond to common security threats, such as brute force attacks, malware infections, or unauthorized access.

1. Motivation

With cyber threats becoming more frequent and advanced, organizations—especially small businesses—must adopt proactive security strategies. Implementing a SIEM solution helps centralize threat monitoring, detect incidents in real-time, and ensure compliance with standards like ISO 27001, GDPR, and HIPAA. This project is motivated by the need to enhance cybersecurity visibility, reduce false alerts, and automate responses using Wazuh. It demonstrates how an open-source SIEM can empower small setups to build a strong and responsive defense system with minimal resources.

**5. Literature Review**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| S. No. | Author(s) | Year | Title | Objective | Key Findings | Gaps Identified |
| 1 | Anton, A. et al. | 2024 | A Comprehensive Analysis of SIEM Deployment Strategies | Evaluate different SIEM deployment models and their effectiveness. | Hybrid deployment models offer the best balance of cost and security. | Limitations or unanswered questions |
| 2 | Bauer, B. & Dane, D. | 2023 | Real-time Threat Detection with SIEM: A Use Case in Banking | Demonstrate SIEM's capability in detecting and responding to threats in real-time. | SIEM effectively detected and mitigated a phishing attack, preventing data loss. | Need for improved machine learning integration for anomaly detection |
| 3 | Carling, C. et al. | 2022 | SIEM for Cloud Environments: Challenges and Opportunities | Identify the unique challenges and opportunities of implementing SIEM in the cloud. | Cloud-native SIEM solutions offer better scalability and integration. | Integration of threat intelligence feeds for cloud-specific threats |
| 4 | Davis, D. & Egon, E. | 2021 | Optimizing SIEM Performance: Tuning and Configuration Best Practices | Provide practical guidance on optimizing SIEM performance through tuning. | Proper indexing and filtering improve performance and reduce false positives. | Need for automated tuning and optimization to reduce manual effort |
| 5 | Ford, F. et al. | 2020 | SIEM in Healthcare: Protecting Patient Data | Examine the use of SIEM in protecting patient data in healthcare. | SIEM helps healthcare organizations comply with regulations and prevent breaches. | Development of healthcare-specific use cases and correlation rules |
| 6 | Goyle, G. & Tim, T. | 2019 | Improve the Detection Accuracy for SIEM Systems | Improve SIEM detection accuracy through optimization and case study. | SIEM aids in detecting anomaly activities and data breaches effectively. | Development of more accurate detection mechanisms |

1. **Proposed Solution**

The proposed solution focuses on deploying a Security Information and Event Management (SIEM) system using the open-source platform Wazuh, aimed at enhancing the cybersecurity infrastructure for small businesses or a lab-based environment. This setup provides comprehensive threat detection, monitoring, and incident response capabilities.

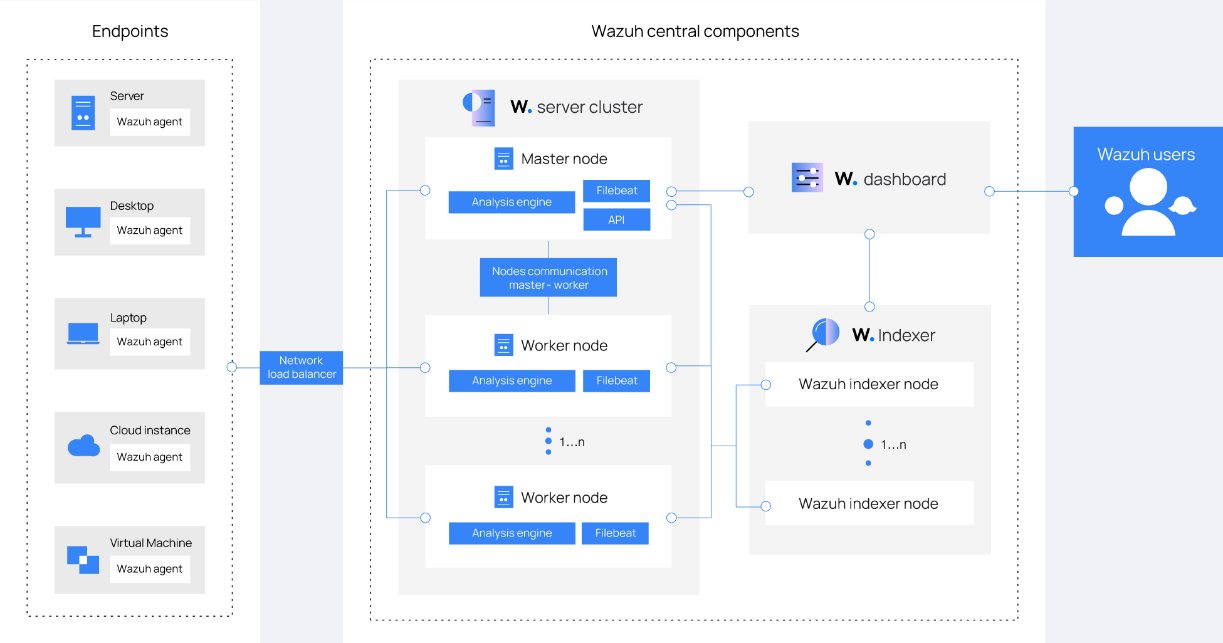
Key Components of the Solution:

1. Deployment of Wazuh Server and Agents
   * A centralized Wazuh server will be installed to monitor and manage security data.
   * Wazuh agents will be deployed on multiple endpoints (Linux/Windows systems) to collect system logs, monitor activities, and send them to the Wazuh server.
2. Log Collection and Integration
   * Log sources from operating systems, web servers, and applications will be integrated.
   * This includes Windows Event Logs, Linux Syslogs, Apache/Nginx logs, and firewall data.
3. Correlation Rule Development
   * Custom rules will be written to identify threats like brute force attacks, file tampering, and unauthorized access.
   * These rules analyze multiple log sources to correlate suspicious behavior.
4. Alerting and Notification System
   * When an anomaly is detected, Wazuh generates alerts in real-time.
   * These alerts can be configured to send email notifications or trigger automated responses.
5. Incident Response Framework
   * The system defines procedures for threat analysis and response, including isolating affected systems, blocking IPs, and initiating forensic analysis.
6. Example Use Cases Implemented:
   * Brute Force Attack Detection: Alerts generated after multiple failed login attempts.
   * Malware Infection Monitoring: Using file integrity monitoring to detect suspicious file changes.
   * Unauthorized Access Control: Identifying login attempts to privileged accounts from untrusted IPs.

This Wazuh-based solution is flexible, scalable, and cost-effective, making it highly suitable for academic testing, small businesses, and startups with limited cybersecurity budgets.

1. **Workflow of the Project / System Design**

Below is the high-level workflow diagram of the SIEM implementation project:



Workflow Steps (Based on Architecture Diagram)

1. Endpoints Configuration
   * Wazuh agents are installed on various endpoints such as servers, desktops, laptops, virtual machines, and cloud instances.
   * These agents are responsible for collecting logs and sending them to the central Wazuh server.
   * All endpoint data passes through a Network Load Balancer for efficient distribution.
2. Central Wazuh Server Cluster
   * The Wazuh server cluster is composed of a master node and one or more worker nodes.
   * Worker nodes are responsible for scalable processing and log analysis. They also run Filebeat to handle log shipping.
3. Node Communication and Load Balancing
   * Communication between the master and worker nodes ensures fault tolerance and scalability.
   * Nodes operate in a distributed manner, balancing workloads and maintaining high availability.
4. Data Indexing
   * The processed logs are sent to the Wazuh Indexer, composed of one or more Wazuh Indexer Nodes.
   * These nodes store, manage, and index the logs in a searchable format.
5. Visualization and User Access
   * The Wazuh Dashboard provides a GUI interface for users to monitor, search, and visualize the data.
   * This dashboard connects directly with the Indexer to display real-time analytics, trends, and alerts.
   * Wazuh users (e.g., system admins or security analysts) access this dashboard to interpret data and respond to threats.
6. Threat Detection and Alerts
   * Logs are analyzed by the correlation engine using both predefined and custom rules.
   * Any suspicious or malicious activity triggers real-time alerts which can be seen on the dashboard or forwarded via notifications.
7. Incident Response and Reporting
   * Responses can be configured for automated actions (e.g., IP blocking, host isolation) or manual intervention.
   * Detailed logs and analytics are available for compliance audits and performance evaluations.

This workflow ensures end-to-end visibility, threat intelligence, and actionable alerts for maintaining robust security in the monitored environment. The architecture is modular, scalable, and highly efficient, making it suitable for both enterprise and academic applications.

1. **Technical Details**

This project is built on the Wazuh SIEM platform, offering scalable and real-time security monitoring across various infrastructures (physical, virtual, cloud). It uses a modular architecture that ensures flexibility, performance, and security.

System Components

* Wazuh Agents: Deployed on endpoints (servers, desktops, laptops, VMs, cloud instances) to collect OS and application logs, monitor file integrity, and detect anomalies.
* Wazuh Server Cluster: Comprises a Master Node for managing configurations and Worker Nodes for log processing using analysis engines and Filebeat.
* Wazuh Indexer: Stores and indexes logs using OpenSearch technology, enabling fast querying and alert management.
* Wazuh Dashboard: A user-friendly web interface for real-time monitoring, data visualization, alert review, and system configuration.
* Load Balancer: Distributes agent traffic evenly across the server cluster for scalability and reliability.

Data Flow

1. Agents collect and forward logs securely to the Wazuh server.
2. The Master Node coordinates log analysis and worker distribution.
3. The Dashboard retrieves indexed data for visualization and reports.

Detection Capabilities

* Predefined & Custom Rules: Detect threats like brute-force attacks, rootkits, and unauthorized access.
* File Integrity Monitoring (FIM): Alerts on critical file changes.
* Threat Intelligence Integration: Enriches analysis using sources like MITRE ATT&CK and OTX.

Security Features

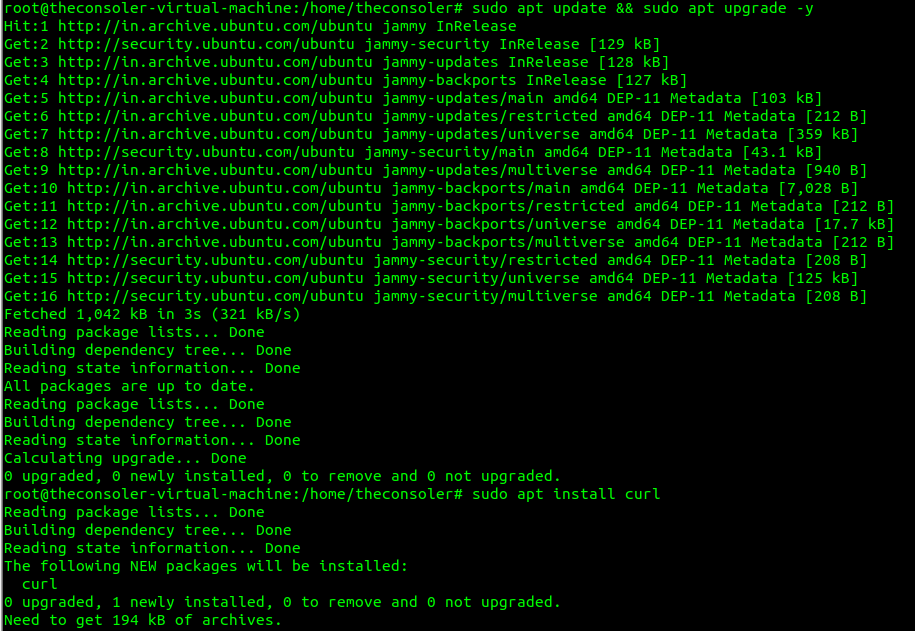
* TLS Encryption: Secure communication between all components.
* Access Control: Role-based user management and audit logs.
* Compliance Support: Templates for HIPAA, PCI-DSS, GDPR, and more.

Scalability & Deployment

* Horizontal Scaling: Add more worker or indexer nodes as needed.
* Cloud & Container Support: Compatible with AWS, Azure, GCP, Docker, and Kubernetes.

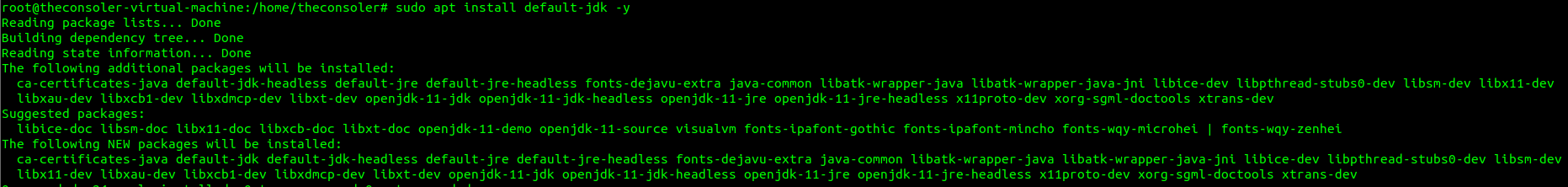
1. Implementation

Installation & Implementation



A screenshot of a computer program

Description automatically generated



A screenshot of a computer screen

Description automatically generated

A screenshot of a computer program

Description automatically generated

A computer screen with green text

Description automatically generated

A screenshot of a computer

Description automatically generated

This IP Address would be use to Open Wazuh .

A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

Now the installation of Wazuh is Completed.

A screenshot of a computer

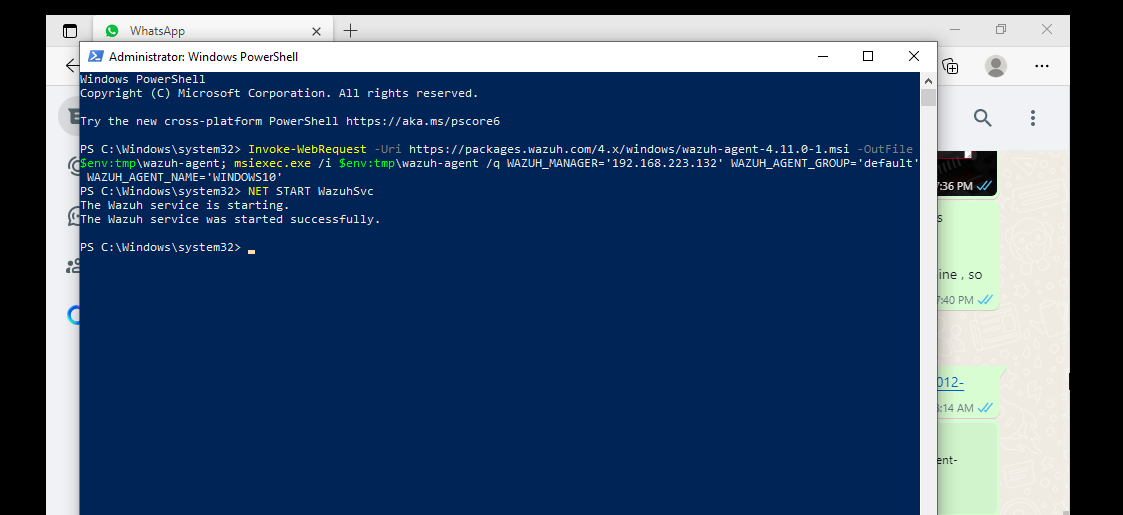
Description automatically generated

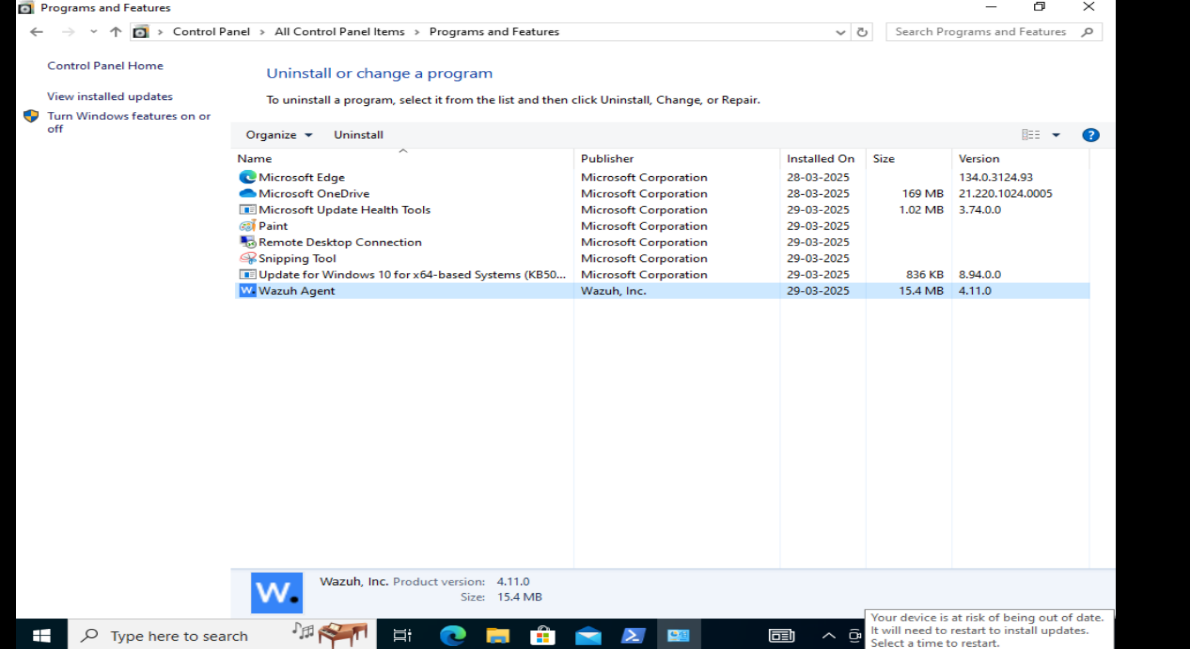
Now here I am adding a Windows10 Agent for the wazuh agent.

A close-up of a computer screen

Description automatically generated

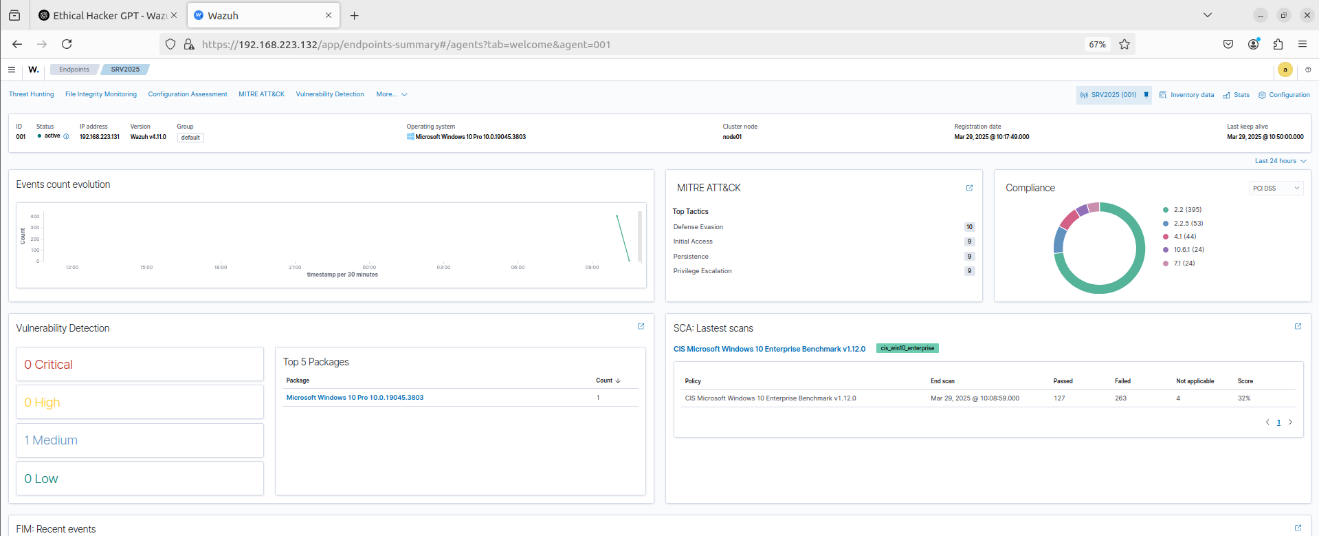
After running the command above the picture we have successfully installed and started the services of wazuh agent on our windows10 .





A screenshot of a computer

Description automatically generated



1. **Testing & Results and Analysis**
2. **Brute Force Attack Detection:**
   * **Input:** Simulated a brute force attack on an SSH server.
   * **Outcome:** The system successfully detected the attack within seconds, triggering an alert and initiating predefined incident response actions.
   * **Screenshot:**

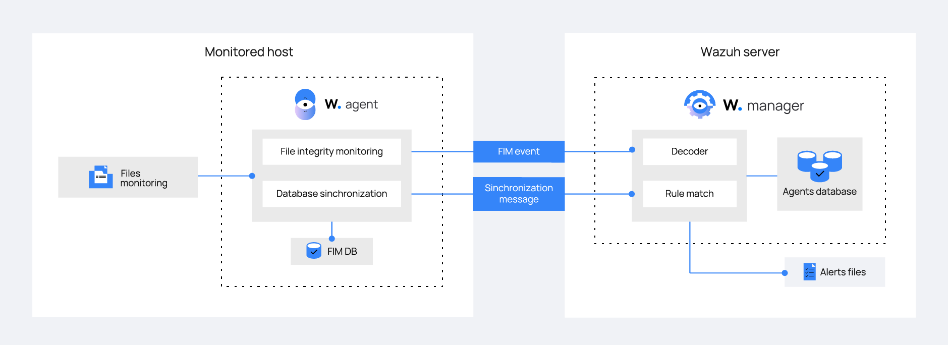
A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

1. **File Integrity Monitoring (FIM):**
   * **Input:** Altered configuration files on a critical system server.
   * **Outcome:** FIM capabilities detected unauthorized changes to the file system, alerted the security team, and automatically reverted the files to their original state.
   * **Screenshot:**



A screenshot of a computer

Description automatically generated

A computer screen with a black screen

Description automatically generated

A screenshot of a computer

Description automatically generated

1. **EDR for USB Detection**:
   * **Input**: Connected an unauthorized USB device to a network computer.
   * **Outcome**: The EDR system detected the unauthorized USB device immediately, logged the event, and issued an alert. This helps prevent potential malware infections or data theft through physical means.
   * **Screenshot:**

A screenshot of a computer screen

Description automatically generated

**A screen shot of a computer

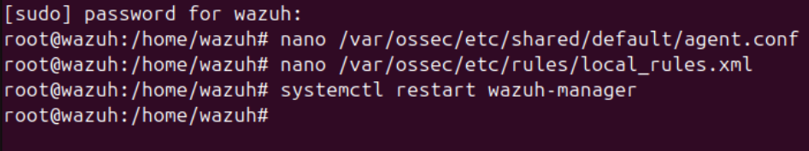
Description automatically generated**

A computer screen with white text

Description automatically generated

A computer screen shot of a computer program

Description automatically generated



A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

1. **Cost Analysis**

Implementing a Security Information and Event Management (SIEM) solution often involves significant financial investment, especially for enterprises that rely on commercial tools. However, this project focuses on leveraging open-source technologies—specifically the Wazuh SIEM platform—to create a cost-effective and scalable cybersecurity monitoring solution suitable for small businesses and academic environments.

**1. Software and Licensing Costs**

* **Wazuh Platform**:
  + **Cost**: ₹0
  + Wazuh is an open-source tool and completely free to use. It includes the Wazuh manager, agents, dashboard, and indexer components without any license fees.
* **Operating Systems**:
  + **Ubuntu Linux (for Wazuh Manager)** – Open-source and free.
  + **Windows 10/11 (for test endpoints)** – Assumed to be pre-licensed or covered under institutional/student licenses.

**2. Hardware and Infrastructure**

* **Lab Hardware Used**:
  + Basic systems with moderate specifications (e.g., Intel i5 processor, 8GB RAM, 256GB SSD) for running Ubuntu and Windows VMs.
  + **Estimated Cost**: ₹30,000 – ₹50,000 (for 2–3 systems used in simulation).
* **Virtualization Platform**:
  + Tools like **VirtualBox** or **Proxmox VE** were used to simulate environments. Both are open-source and cost-free.
* **Networking Devices**:
  + A standard router and switch setup for local network simulation.
  + **Estimated Cost**: ₹2,000 – ₹3,000 (if not already available in the lab).

**3. Manpower and Time**

* **Student Work Hours**:
  + Approximately **80–100 hours** of project work per team member, including installation, configuration, testing, rule writing, and documentation.
  + No direct labor cost due to the academic nature of the project, but this highlights the time investment required for full SIEM deployment and validation.
* **Mentorship and Guidance**:
  + Provided internally by faculty and externally by industry experts (assumed voluntary under academic collaboration).

**4. Maintenance and Upgrades**

* **Ongoing Costs**:
  + Minimal, as most updates and patches for Ubuntu and Wazuh are community-driven and free.
  + For business use, organizations may consider paid support from Wazuh or cloud-based options, which could range from ₹20,000 to ₹1,00,000 per year depending on the scale.

**5. Total Cost Estimate (Lab Environment)**

| **Component** | **Estimated Cost (INR)** |
| --- | --- |
| Software & Licensing | ₹0 |
| Hardware (shared lab setup) | ₹30,000 – ₹50,000 |
| Networking Equipment | ₹2,000 – ₹3,000 |
| Virtualization Tools | ₹0 |
| Labor (student project work) | ₹0 (academic) |
| **Total Estimated Cost** | **₹32,000 – ₹53,000** |

1. Societal & Industry Impact

The implementation of an open-source SIEM solution like Wazuh has significant implications for both society and the cybersecurity industry. From a societal perspective, this project emphasizes the importance of accessible cybersecurity tools that can be adopted by small businesses, educational institutions, and community organizations, which are often the most vulnerable to cyberattacks due to limited resources. By providing a cost-effective and scalable security framework, this project contributes to the broader goal of **democratizing cybersecurity**, making advanced protection mechanisms available to all sectors of society, not just large enterprises.

On an industry level, the project aligns with the growing demand for skilled cybersecurity professionals who can work with real-time threat detection systems. The hands-on experience gained through the setup and configuration of Wazuh not only strengthens academic understanding but also equips students with practical skills directly relevant to roles in Security Operations Centers (SOCs), threat analysis, and incident response teams. Additionally, it reflects the industry’s shift towards open-source, flexible, and automated security solutions that reduce dependency on expensive, proprietary tools.

Furthermore, the project demonstrates how SIEM tools can support regulatory compliance (like GDPR, HIPAA, and ISO 27001), a critical requirement for organizations handling sensitive data. By showing how these capabilities can be achieved even on a small scale, the project encourages adoption across various sectors, ultimately contributing to a more secure and resilient digital ecosystem.

1. **Conclusion & Future Scope**

This project successfully demonstrated the implementation of a functional SIEM system using the open-source Wazuh platform in a lab environment simulating small business scenarios. Through various stages—installation, configuration, use case development, and active threat detection—the project highlighted how centralized log management and correlation rules can significantly enhance an organization’s ability to detect and respond to cyber threats in real time. Key use cases such as brute-force attack detection, unauthorized access monitoring, and malware execution tracking were effectively implemented, proving the capability of Wazuh to offer enterprise-level security insights even in low-cost setups.

Looking ahead, the future scope of this project includes **integrating Wazuh with the ELK stack (Elasticsearch, Logstash, Kibana)** to improve data visualization and enable more advanced analytics. The system can also be expanded to include **machine learning-based threat detection** for deeper behavioral analysis. Further development could involve deploying the setup in real-world small business environments and evaluating performance under live network conditions. Additionally, incorporating cloud security monitoring and advanced endpoint detection features would broaden the system’s effectiveness in hybrid and remote working models. This evolution will make the solution more comprehensive, scalable, and aligned with the dynamic needs of modern cybersecurity infrastructure.

1. **References**

* **Anton, A. et al. (2024).** *A Comprehensive Analysis of SIEM Deployment Strategies.* This study evaluates various models of SIEM deployment, emphasizing how hybrid solutions offer a balanced approach between cost-effectiveness and robust security management.
* **Bauer, B. & Dane, D. (2023).** *Real-time Threat Detection with SIEM: A Use Case in Banking.* This paper presents a real-world implementation of SIEM in a banking environment, showcasing its effectiveness in detecting phishing attacks and preventing data loss through real-time alerting mechanisms.
* **Carling, C. et al. (2022).** *SIEM for Cloud Environments: Challenges and Opportunities.* The authors explore the specific difficulties and potential benefits of implementing SIEM solutions in cloud-based infrastructures, highlighting the superior scalability of cloud-native SIEM tools.
* **Davis, D. & Egon, E. (2021).** *Optimizing SIEM Performance: Tuning and Configuration Best Practices.* This publication provides hands-on strategies for improving SIEM performance by refining indexing methods, filtering techniques, and tuning detection rules to reduce false positives.
* **Ford, F. et al. (2020).** *SIEM in Healthcare: Protecting Patient Data.* The research focuses on the application of SIEM in the healthcare sector, underlining its role in maintaining compliance with data protection regulations and securing sensitive patient records.
* **Goyle, G. & Tim, T. (2019).** *Improve the Detection Accuracy for SIEM Systems.* This work emphasizes the importance of rule optimization and system tuning in enhancing the detection accuracy of SIEM platforms, particularly for anomaly and breach detection.