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Chapter 1: Problem Definition

In today’s digital world, cloud computing plays a vital role in hosting applications and storing data. However, as more services move to the cloud, the risk of security threats like unauthorized access, data breaches, and suspicious user activity increases. Traditional methods of monitoring and securing cloud environments often fall short when it comes to real-time detection and response to such threats.

Our project aims to solve this issue by building an AI-powered cloud security monitoring system using Microsoft Azure. The goal is to create a system that can automatically collect, analyse, and visualize security logs from a web application, identify unusual behaviour using AI tools, and respond quickly to high-risk events.

We use tools like Azure Sentinel, Azure Monitor, Event Hub and Logic Apps to build a complete monitoring pipeline. This helps detect threats in real time, send alerts when something suspicious happens, and provide clear dashboards to track user activity and security events. The system also supports automation, reducing the need for manual intervention and improving overall cloud security.

Chapter 2: Introduction

Cloud computing has fundamentally transformed how applications are built, deployed, and managed. It offers scalability, flexibility, and cost-effectiveness, making it an essential backbone for modern digital infrastructure. With its ability to host applications, store vast amounts of data, and facilitate global access, the cloud has become the preferred choice for enterprises, startups, and educational institutions alike. However, this widespread adoption of cloud technologies has also introduced a new set of challenges—chief among them being cloud security.

As organizations move sensitive data and services to cloud platforms, they become increasingly vulnerable to a variety of security threats, including unauthorized access, account hijacking, privilege escalation, and data breaches. According to the 2024 Cloud Security Report by Cybersecurity Insiders, over 76% of organizations expressed moderate to high concern about cloud security, particularly with visibility into cloud infrastructure and real-time threat detection capabilities [1]. This concern is especially critical in applications that involve user authentication and data storage, such as web-based systems.

Traditional security solutions are not always equipped to handle the dynamic and distributed nature of cloud environments. These older systems often rely on manual monitoring, static rule-based alerting, or periodic reviews of logs—methods that fall short when dealing with modern cyber threats that evolve in real time. Hence, there's an urgent need for an automated, intelligent, and centralized monitoring system that can adapt quickly, analyse behaviour patterns, and respond to threats without delay [2].

Our project, AI-Powered Cloud Security Monitoring Using Microsoft Azure, aims to bridge this gap by integrating Artificial Intelligence (AI) with robust cloud-native tools for real-time security monitoring. This system leverages several core Azure services, including Azure Sentinel, a cloud-native Security Information and Event Management (SIEM) solution, Azure Monitor for collecting metrics and logs, Azure Event Hub for real-time event streaming, and Logic Apps to automate incident response [3].

A key innovation in this project is the integration of AI-based anomaly detection using either Microsoft Defender for Cloud or Azure's built-in analytics tools. These tools utilize machine learning models that can learn from historical login behaviour, detect outliers, and flag unusual activities such as logins from new locations, unexpected time zones, or an abnormal frequency of failed login attempts. This intelligence helps prevent false positives while ensuring that genuine threats are detected swiftly.

Another important aspect of the project is its real-time, end-to-end data pipeline. The system collects custom logs (AppTraces) from a Django-based web application hosted in the cloud. These logs are sent to Log Analytics Workspaces using a Data Collection Rule (DCR) and are then analysed within Azure Sentinel. If a high-severity event is detected, Logic Apps are triggered to send automated emails or alerts to administrators, ensuring a quick response. Additionally, these logs are streamed to Event Hub to allow for scalable processing and visualization [4].

The significance of this project lies in its holistic and modular design. It demonstrates how various Azure services can be orchestrated together to build a full-fledged cloud security monitoring system. It also serves as an educational case study for understanding cloud-native security principles and the importance of proactive threat management [5].

As cyber threats become increasingly sophisticated, projects like this represent a critical step toward more secure cloud ecosystems. The solution not only reduces the reliance on manual monitoring but also improves system resilience and enhances trust in digital services [6].

Chapter 3: Description

This chapter provides a detailed description of the services, methodologies, and software tools used in the implementation of the project titled *AI-Powered Cloud Security Monitoring Using Microsoft Azure*. The project aims to design a scalable and intelligent security monitoring pipeline that can detect, analyse, and visualize security threats in real time using Microsoft's Azure cloud ecosystem [7][8].

3.1 Cloud Services Used

To build a robust security monitoring architecture, the project integrates several services offered by Microsoft Azure. Each component serves a specific purpose and contributes to the automation and intelligence of the entire system.

3.1.1 Azure Monitor

Azure Monitor is a foundational service that collects, analyses, and acts on telemetry data gathered from both cloud and on-premise environments. It was used in this project to gather custom logs, particularly login attempts and access logs generated from the Django web application. A Data Collection Rule (DCR) was configured to stream AppTraces data from the application to a Log Analytics Workspace for centralized monitoring.

3.1.2 Log Analytics Workspace

The Log Analytics Workspace serves as a centralized repository where collected log data is stored and queried. It allows advanced search using Kusto Query Language (KQL), enabling developers and security analysts to identify specific patterns, detect anomalies, and visualize trends in user activity.

3.1.3 Azure Sentinel

Azure Sentinel is a cloud-native SIEM (Security Information and Event Management) and SOAR (Security Orchestration Automated Response) platform. It was used to process the logs collected from Azure Monitor, detect high-risk security incidents using built-in analytics and machine learning models, and generate actionable alerts. It acts as the intelligence hub for the monitoring pipeline.

3.1.4 Azure Event Hub

Azure Event Hub was integrated into the system as a real-time data ingestion pipeline. It facilitates the streaming of telemetry and security logs between services and enhances the responsiveness of the system. By using Event Hub, the system ensures minimal latency when transmitting logs from the source (Django app) to Azure services for processing.

3.1.5 Azure Logic Apps

Logic Apps provide workflow automation and were utilized to respond automatically to detected security threats. For example, when a high-severity log is ingested (such as repeated failed login attempts), a Logic App triggers an action—such as sending an email to administrators or creating an incident in the security operations centre (SOC). This reduces response time and increases efficiency in handling threats.

3.2 Methodology

The methodology adopted for the development of this project followed a layered and modular design approach to ensure scalability, real-time processing, and automation.

3.2.1 Data Generation and Logging

The first step involved creating a Django web application that logs user login activity and records it as custom events. These events include details such as user ID, timestamp, event type (login/logout), IP address, and severity level. These logs were stored locally and then streamed to Azure Monitor using AppTraces.

3.2.2 Ingestion and Centralization

A Data Collection Rule (DCR) was defined to route AppTraces from the Django application to the Log Analytics Workspace. This enabled the logs to be processed by Azure Monitor and Sentinel for further analysis. Logs were queried and verified using Kusto queries within the Azure portal.

3.2.3 Real-time Processing and Alerting

Once logs were flowing into the system, Azure Sentinel was configured with analytics rules to detect high-risk behaviours. For instance, a rule was created to flag an account if there were multiple failed logins attempts within a short span of time. When such a pattern was detected, an alert was generated and an incident was created within Sentinel.

3.2.4 Automation with Logic Apps

Using Logic Apps, a playbook was created to automate the response to these alerts. This included actions such as sending notification emails to administrators, updating dashboards, or escalating the event for manual investigation.

3.3 Software Requirements

The software tools and technologies used in the implementation of this project are listed in Table 1

Software/Service	Purpose
Django (Python Web Framework)	Frontend and backend for user login system
Visual Studio Code	Code development and debugging environment
GitHub	Version control and collaboration
Microsoft Azure Portal	Cloud services provisioning and configuration
Azure Monitor & Sentinel	Log ingestion, detection, and SIEM configuration
Azure Logic Apps	Automating responses to incidents
Kusto Query Language (KQL)	Querying log data in Azure
Azure Event Hub	Real-time data streaming platform for ingesting and forwarding telemetry logs.
App Traces	Custom log data generated by the Django application, used for tracking login activities and events.
Microsoft Defender	Provides threat detection, security posture management, and AI-driven alerts across cloud workloads.

Chapter 4: Implementation details

The implementation of the project titled *AI-Powered Cloud Security Monitoring Using Microsoft Azure* follows a modular and cloud-native design. The system leverages Microsoft Azure's suite of services integrated with a Django-based web application to enable real-time threat detection, automated responses, and comprehensive security visualization.

The architecture as shown in figure 1 begins with a Django web application that functions as the frontend for user login. This application generates structured logs for each login activity, capturing details such as the username, timestamp, IP address, and event type (success or failure). These logs, referred to as AppTraces, form the primary input for the monitoring pipeline. The logs are configured to be streamed to Azure Monitor through a Data Collection Rule (DCR), enabling centralized log ingestion and analysis [9].

Once the logs are collected, they are stored in a Log Analytics Workspace, where they can be queried using Kusto Query Language (KQL). This workspace forms the backbone of data analysis and serves as the central repository for all collected telemetry. The data is then accessed by Azure Sentinel, a cloud-native Security Information and Event Management (SIEM) solution. Azure Sentinel applies analytics rules and built-in machine learning models to identify suspicious behaviours such as multiple failed logins attempts or logins from unusual locations. These detections are configured to generate alerts and incidents, which are used to trigger appropriate responses.

For real-time processing and low-latency event streaming, Azure Event Hub is integrated into the architecture. Event Hub acts as a scalable data ingestion service, allowing for efficient communication between the Django application and Azure services. This ensures timely transmission of telemetry data, which is crucial for proactive threat management.

To enhance system responsiveness, Azure Logic Apps are employed to automate incident handling. Logic Apps are configured with playbooks that execute predefined workflows in response to alerts raised by Sentinel. For instance, when a high-severity event such as multiple failed login attempts is detected, a Logic App triggers an automated email alert to the administrator. These workflows reduce the time required for manual monitoring and allow administrators to take quick, informed actions [10][11].

The entire stack is implemented using a combination of open-source and proprietary tools. The Django framework handles the application logic and logging on the server side. Code development was done in Visual Studio Code, and GitHub was used for version control and collaboration. Microsoft Azure Portal was the primary interface for provisioning and configuring all cloud resources.

Together, this implementation delivers a scalable, intelligent, and automated cloud security monitoring system. It successfully demonstrates how Azure's ecosystem can be harnessed to create a responsive and robust monitoring pipeline that meets modern cloud security needs[12].

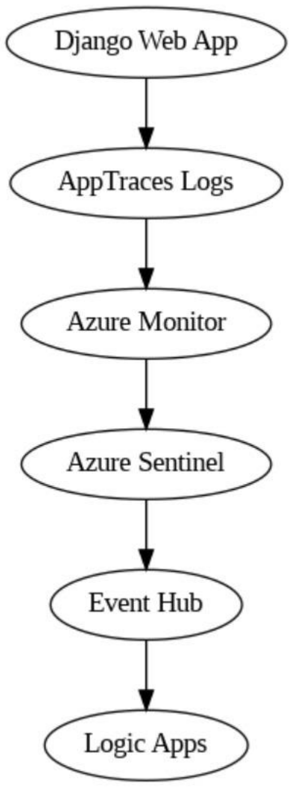
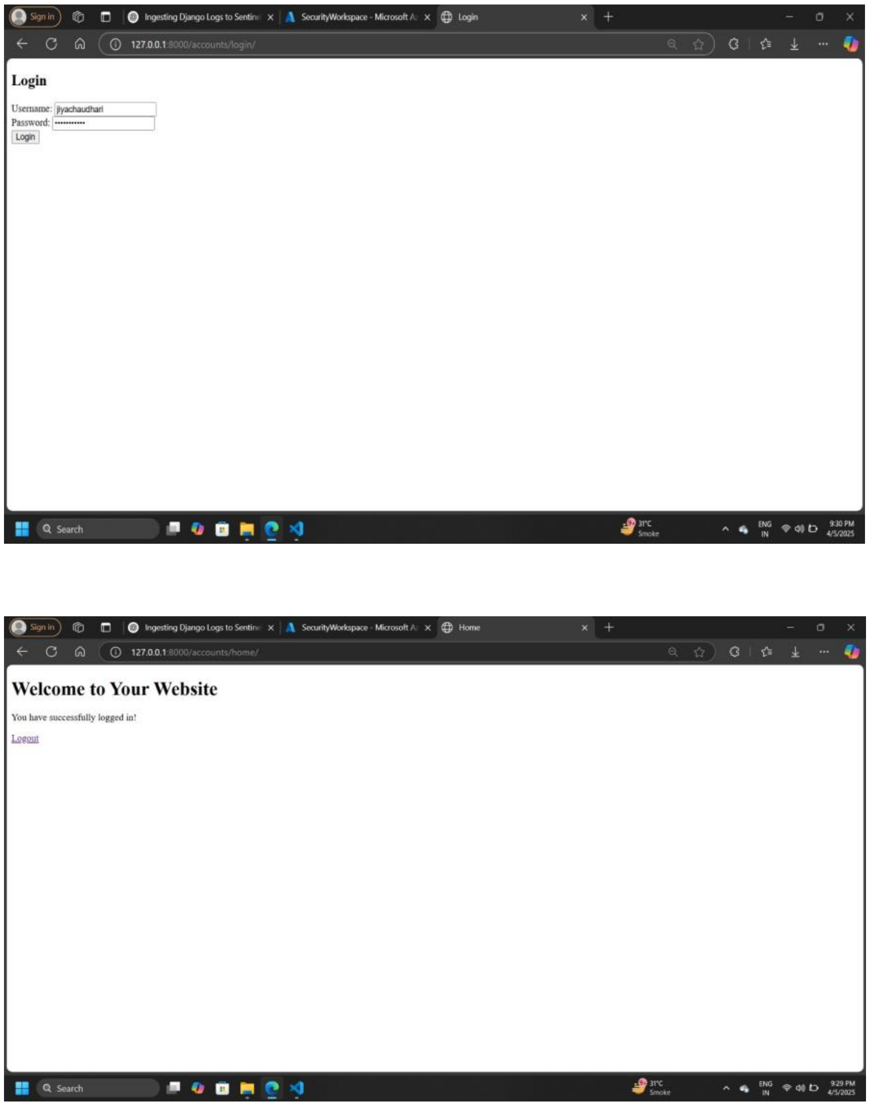


Fig 1: Architecture Block Diagram

Figure 2 shows the Django-based login page used to generate user authentication logs. The terminal output displays real-time logging of user activity, which is later analyzed in Azure.


Sign in
Ingesting Django Logs to Sentine
SecurityWorkspace - Microsoft A
Login
127.0.0.1:8000/accounts/login/
Search
9:30 PM
4/5/2025
Home
127.0.0.1:8000/accounts/home/
9:29 PM

Login

Username: jiyachaudhari
Password: ••••••••••
Login

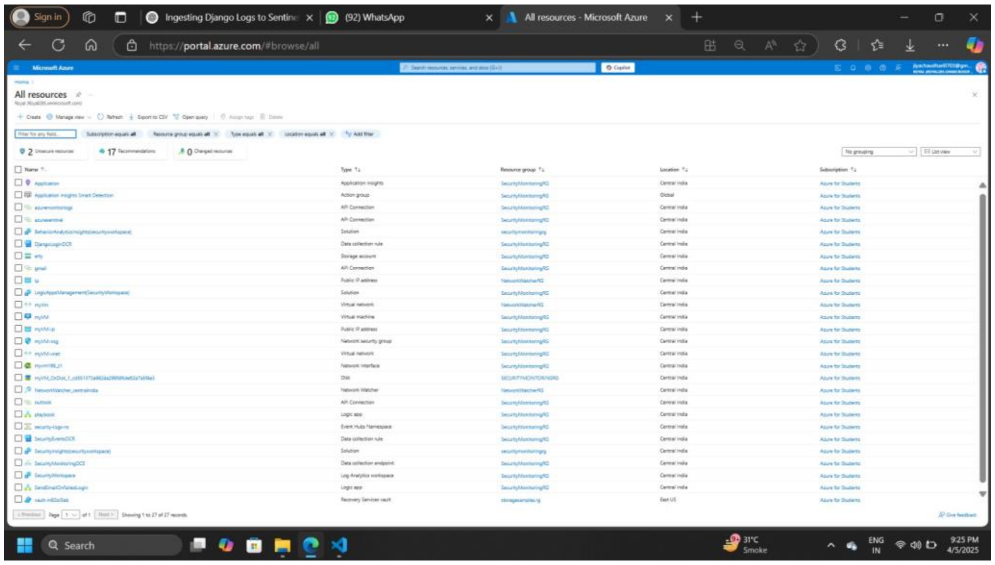
Welcome to Your Website

You have successfully logged in!

Logout

Fig 2: Django Web Application – User Login Interface

Figure 3 presents an overview of all deployed resources on the Microsoft Azure portal. It includes key services like Log Analytics, Sentinel, Event Hub, and Logic Apps used in the project.



All resources

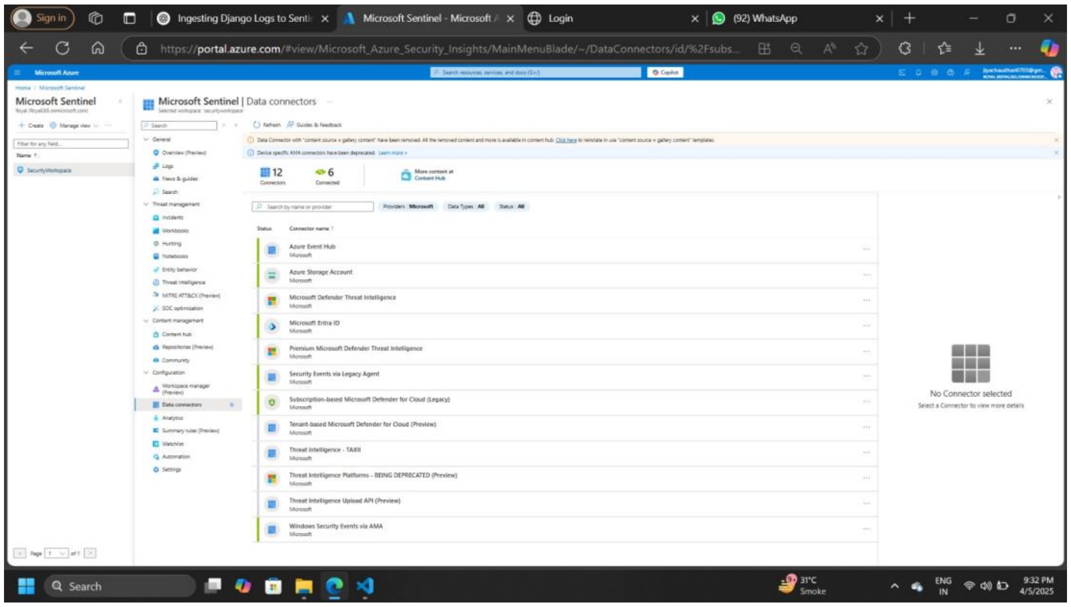
2 Unsecure resources · 17 Recommendations · 0 Changed resources

Name	Type	Resource group	Location	Subscription
Application	Application Insights	SecurityMonitoringRG	Central India	Azure for Students
Application Insights Smart Detection	Action group	SecurityMonitoringRG	Global	Azure for Students
azuremonitorlogs	API Connection	SecurityMonitoringRG	Central India	Azure for Students
azuresentinel	API Connection	SecurityMonitoringRG	Central India	Azure for Students
BehaviorAnalyticsInsights(securityworkspace)	Solution	securitymonitoringrg	Central India	Azure for Students
DjangoLogsDCR	Data collection rule	SecurityMonitoringRG	Central India	Azure for Students
erty	Storage account	SecurityMonitoringRG	Central India	Azure for Students
gmail	API Connection	SecurityMonitoringRG	Central India	Azure for Students
ip	Public IP address	NetworkWatcherRG	Central India	Azure for Students
LogicAppsManagement(SecurityWorkspace)	Solution	SecurityMonitoringRG	Central India	Azure for Students
myVm	Virtual network	NetworkWatcherRG	Central India	Azure for Students
myVM	Virtual machine	SecurityMonitoringRG	Central India	Azure for Students
myVM-ip	Public IP address	SecurityMonitoringRG	Central India	Azure for Students
myVM-nsg	Network security group	SecurityMonitoringRG	Central India	Azure for Students
myVM-vnet	Virtual network	SecurityMonitoringRG	Central India	Azure for Students
myvm198_z1	Network Interface	SecurityMonitoringRG	Central India	Azure for Students
myVM_OsDisk_1_[illegible]	Disk	SECURITYMONITORINGRG	Central India	Azure for Students
NetworkWatcher_centralindia	Network Watcher	NetworkWatcherRG	Central India	Azure for Students
outlook	API Connection	SecurityMonitoringRG	Central India	Azure for Students
playbook	Logic app	SecurityMonitoringRG	Central India	Azure for Students
security-logs-ns	Event Hubs Namespace	SecurityMonitoringRG	Central India	Azure for Students
SecurityEventsDCR	Data collection rule	SecurityMonitoringRG	Central India	Azure for Students
SecurityInsights(securityworkspace)	Solution	securitymonitoringrg	Central India	Azure for Students
SecurityMonitoringDCE	Data collection endpoint	SecurityMonitoringRG	Central India	Azure for Students
SecurityWorkspace	Log Analytics workspace	SecurityMonitoringRG	Central India	Azure for Students
SendEmailOnFailedLogin	Logic app	SecurityMonitoringRG	Central India	Azure for Students
vault-[illegible]	Recovery Services vault	storagesamples-rg	East US	Azure for Students

< Previous Page 1 of 1 Next > Showing 1 to 27 of 27 records.

Fig 3: All Resources

Figure 4 highlights the available and configured data connectors within Azure Sentinel. These connectors facilitate log ingestion from various sources such as Event Hub and Azure Monitor.



Microsoft Sentinel | Data connectors

Selected workspace: 'securityworkspace'

Data Connector with "content source » gallery content" have been removed. All the removed content and more is available in content hub. Click here to reinstate in use "content source » gallery content" templates.

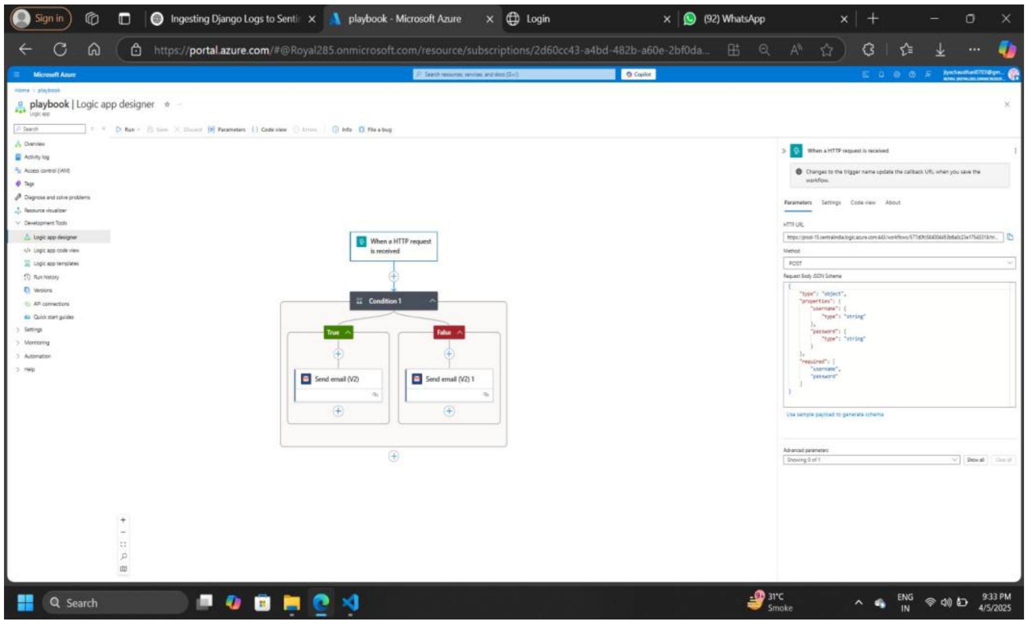
Device specific AMA connectors have been deprecated. Learn more »

12 Connectors · 6 Connected

Status	Connector name
	Azure Event Hub Microsoft
	Azure Storage Account Microsoft
	Microsoft Defender Threat Intelligence Microsoft
	Microsoft Entra ID Microsoft
	Premium Microsoft Defender Threat Intelligence Microsoft
	Security Events via Legacy Agent Microsoft
	Subscription-based Microsoft Defender for Cloud (Legacy) Microsoft
	Tenant-based Microsoft Defender for Cloud (Preview) Microsoft
	Threat Intelligence - TAXII Microsoft
	Threat Intelligence Platforms - BEING DEPRECATED (Preview) Microsoft
	Threat Intelligence Upload API (Preview) Microsoft
	Windows Security Events via AMA Microsoft

Fig 4: Data Connectors

The figure 5 shows the workflow created using Azure Logic Apps. It illustrates how alerts from Sentinel trigger automated responses like email notifications.



When a HTTP request is received

Changes to the trigger name update the callback URL when you save the workflow.

HTTP URL: https://prod-15.centralindia.logic.azure.com:443/workflows/...

Method: POST

Request Body JSON Schema

```
{
    "type": "object",
    "properties": {
        "username": {
            "type": "string"
        },
        "password": {
            "type": "string"
        }
    },
    "required": [
        "username",
        "password"
    ]
}
```

Fig 5: Logic app designer

The figure 6 captures the raw logs generated by the Django web application. The logs include metadata like timestamps, IP addresses, and login statuses.

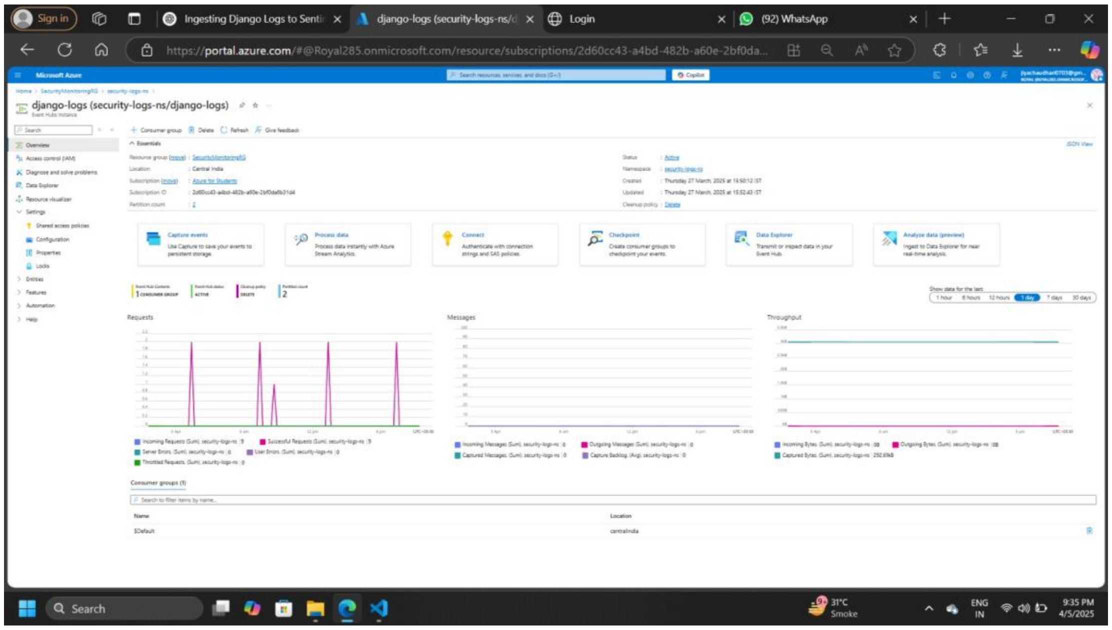
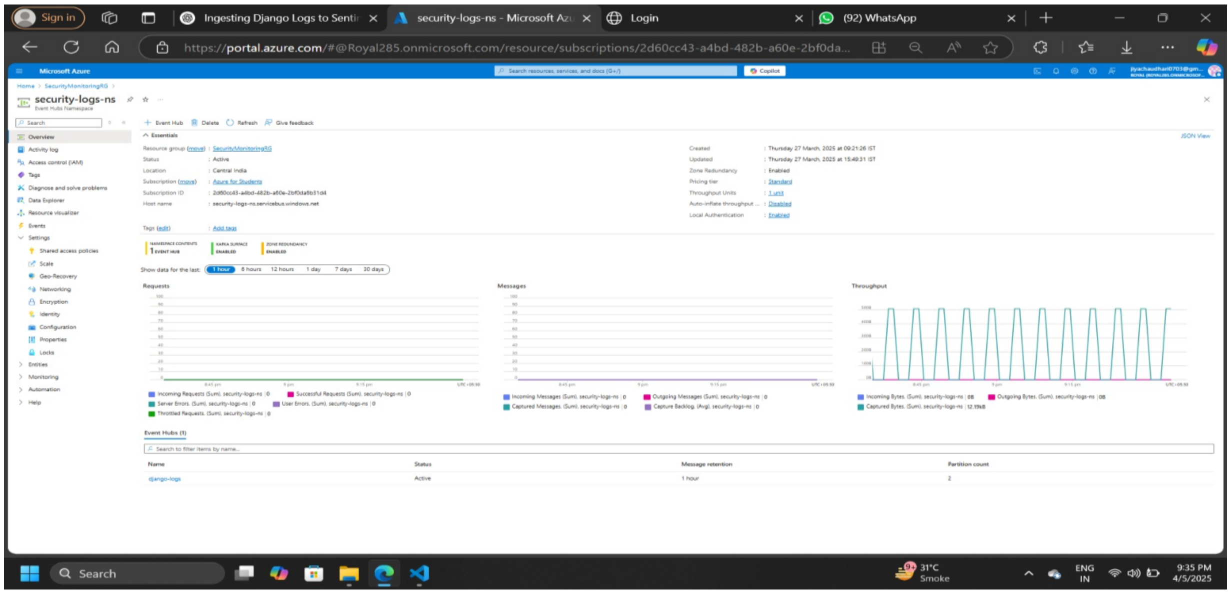


Fig 6: Django logs

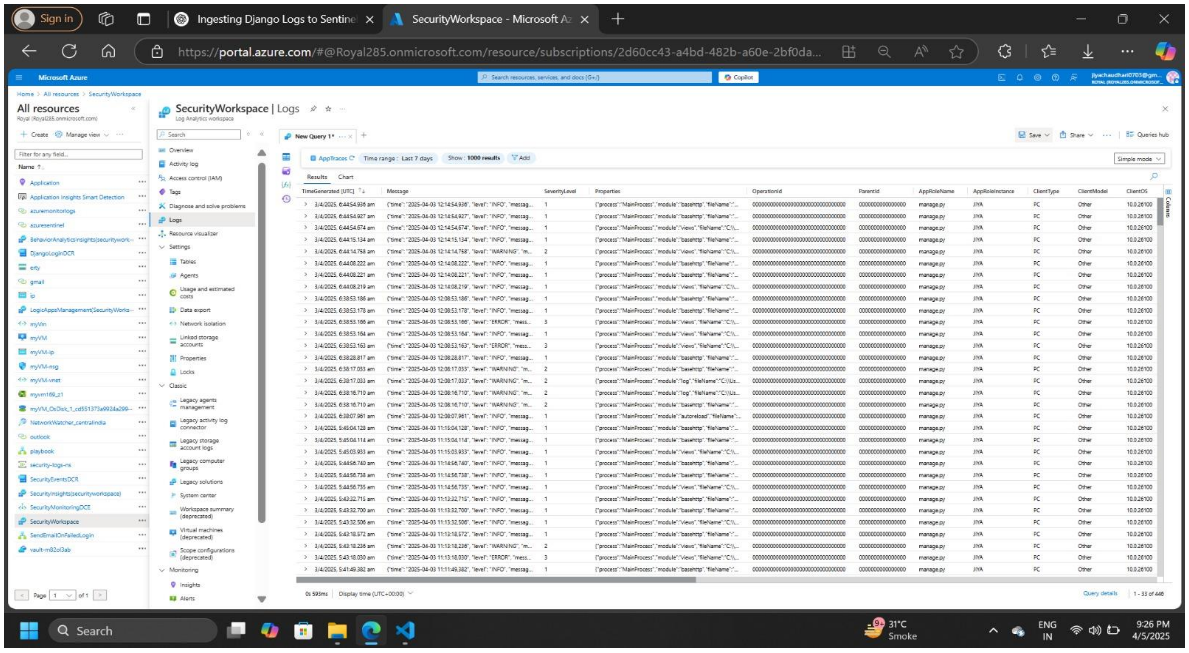
Figure 7 displays how the security logs appear inside Azure Sentinel. It shows detailed log entries used for threat analysis and anomaly detection.



https://portal.azure.com/#@Royal285.onmicrosoft.com/resource/subscriptions/2d60cc43-a4bd-482b-a60e-2bf0da...

Resource group (move)	SecurityMonitoringRG	Created	Thursday 27 March, 2025 at 09:21:26 IST
Status	Active	Updated	Thursday 27 March, 2025 at 15:49:31 IST
Location	Central India	Zone Redundancy	Enabled
Subscription (move)	Azure for Students	Pricing tier	Standard
Subscription ID	2d60cc43-a4bd-482b-a60e-2bf0da6b31d4	Throughput Units	1 unit
Host name	security-logs-ns.servicebus.windows.net	Auto-inflate throughput ...	Disabled
		Local Authentication	Enabled

Name	Status	Message retention	Partition count
django-logs	Active	1 hour	2



```
TimeGenerated [UTC]        Message                                                       SeverityLevel  Properties
3/4/2025, 6:44:54.936 am   {"time": "2025-04-03 12:14:54,936", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:44:54.927 am   {"time": "2025-04-03 12:14:54,927", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:44:54.674 am   {"time": "2025-04-03 12:14:54,674", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 6:44:15.134 am   {"time": "2025-04-03 12:14:15,134", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:44:14.758 am   {"time": "2025-04-03 12:14:14,758", "level": "WARNING", "m...        2   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 6:44:08.222 am   {"time": "2025-04-03 12:14:08,222", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:44:08.221 am   {"time": "2025-04-03 12:14:08,221", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:44:08.219 am   {"time": "2025-04-03 12:14:08,219", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"views","fileName":"C:\\...
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3/4/2025, 6:38:53.178 am   {"time": "2025-04-03 12:08:53,178", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:38:53.166 am   {"time": "2025-04-03 12:08:53,166", "level": "ERROR", "mess...      3   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 6:38:53.164 am   {"time": "2025-04-03 12:08:53,164", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 6:38:53.163 am   {"time": "2025-04-03 12:08:53,163", "level": "ERROR", "mess...      3   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 6:38:28.817 am   {"time": "2025-04-03 12:08:28,817", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:38:17.033 am   {"time": "2025-04-03 12:08:17,033", "level": "WARNING", "m...        2   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:38:17.033 am   {"time": "2025-04-03 12:08:17,033", "level": "WARNING", "m...        2   {"process":"MainProcess","module":"log","fileName":"C:\\Us...
3/4/2025, 6:38:16.710 am   {"time": "2025-04-03 12:08:16,710", "level": "WARNING", "m...        2   {"process":"MainProcess","module":"log","fileName":"C:\\Us...
3/4/2025, 6:38:16.710 am   {"time": "2025-04-03 12:08:16,710", "level": "WARNING", "m...        2   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 6:38:07.961 am   {"time": "2025-04-03 12:08:07,961", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"autoreload","fileName":...
3/4/2025, 5:45:04.128 am   {"time": "2025-04-03 11:15:04,128", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 5:45:04.114 am   {"time": "2025-04-03 11:15:04,114", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 5:45:03.933 am   {"time": "2025-04-03 11:15:03,933", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 5:44:56.740 am   {"time": "2025-04-03 11:14:56,740", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 5:44:56.738 am   {"time": "2025-04-03 11:14:56,738", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 5:44:56.735 am   {"time": "2025-04-03 11:14:56,735", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 5:43:32.715 am   {"time": "2025-04-03 11:13:32,715", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 5:43:32.700 am   {"time": "2025-04-03 11:13:32,700", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 5:43:32.506 am   {"time": "2025-04-03 11:13:32,506", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 5:43:18.572 am   {"time": "2025-04-03 11:13:18,572", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
3/4/2025, 5:43:18.236 am   {"time": "2025-04-03 11:13:18,236", "level": "WARNING", "m...        2   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 5:43:18.030 am   {"time": "2025-04-03 11:13:18,030", "level": "ERROR", "mess...      3   {"process":"MainProcess","module":"views","fileName":"C:\\...
3/4/2025, 5:41:49.382 am   {"time": "2025-04-03 11:11:49,382", "level": "INFO", "messag...     1   {"process":"MainProcess","module":"basehttp","fileName":"...
0s 593ms | Display time (UTC+00:00)
```
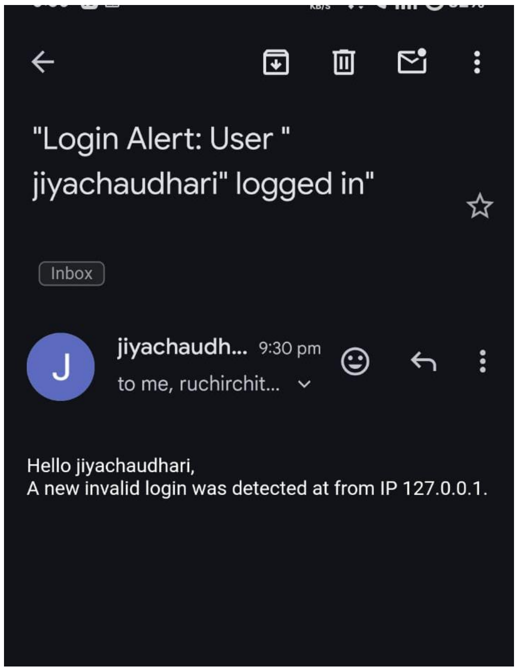

Fig 7: Security Logs

The figure 8 shows successful emails confirming invalid or valid user authentication. It validates that the Logic Apps with the web application integration is functional.

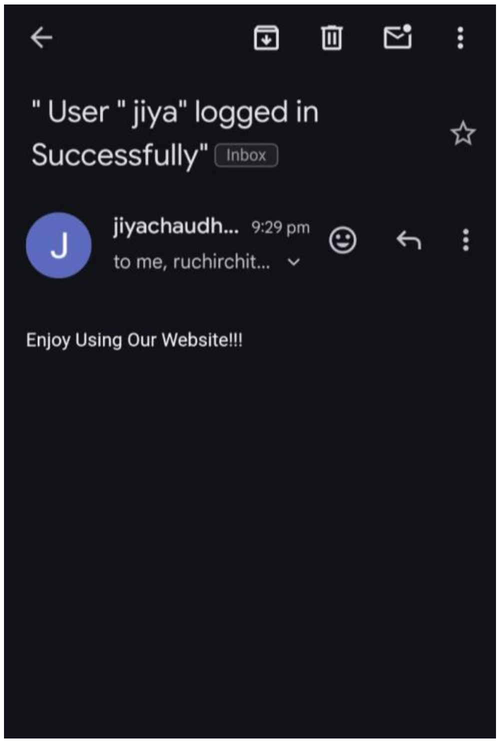


"Login Alert: User " jiyachaudhari" logged in"

Inbox

jiyachaudh... 9:30 pm
to me, ruchirchit...

Hello jiyachaudhari,
A new invalid login was detected at from IP 127.0.0.1.



" User " jiya" logged in Successfully" Inbox

jiyachaudh... 9:29 pm
to me, ruchirchit...

Enjoy Using Our Website!!!

Fig 8: Invalid and Valid Emails

5. Conclusion

The project successfully demonstrates the design and deployment of an AI-powered cloud security monitoring system using Microsoft Azure services. By integrating a Django-based web application with Azure Sentinel, Monitor, Event Hub, App Traces and Logic Apps the system enables real-time threat detection, automated incident response, and insightful visualizations. The use of AI-based analytics enhances the accuracy and efficiency of detecting unusual login behaviour, thereby reducing the risk of unauthorized access and data breaches. This project highlights the potential of cloud-native tools in building scalable, intelligent, and responsive security infrastructures that meet the evolving demands of modern digital ecosystems.

In the future, the system can be expanded to support multiple applications and integrate more advanced AI models for predictive threat analytics. Incorporating user behaviour analytics (UBA) and integrating Microsoft Defender for Cloud can further strengthen proactive threat detection. Support for multi-cloud environments such as AWS and Google Cloud can be added to create a unified security monitoring framework. Additionally, integrating Natural Language Processing (NLP) for alert summaries and chatbot-based incident response can enhance usability for non-technical stakeholders. This project lays a strong foundation for building robust, AI-driven cloud security solutions adaptable to enterprise-scale deployments.

6. References

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