Serverless Customer Feedback System with AWS Comprehend and QuickSight

A Course Project Report Submitted in partial fulfillment of the course requirements for the award of grades in the subject of

CLOUD BASED AIML SPECIALITY
(22SDCS07A)

by

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Certificate

This is Certified that the project entitled **"Serverless Customer Feedback System with AWS Comprehend and QuickSight"** which is a experimental &/ Simulation work carried out by S.Jahnavi (2210030485), in partial fulfillment of the course requirements for the award of grades in the subject of **CLOUD BASED AIML SPECIALITY**, during the year **2024-2025**. The project has been approved as it satisfies the academic requirements.

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Course Instructor

CONTENTS

1. INTRODUCTION

The Serverless Customer Feedback System using AWS Comprehend and QuickSight provides a scalable, cost-effective, and intelligent method for businesses to collect, process, and analyze customer feedback in real-time. By leveraging serverless technologies, the solution minimizes infrastructure management while offering powerful tools for natural language processing and data visualization.

Amazon Comprehend, a fully managed NLP service, plays a central role by performing sentiment analysis on incoming feedback. It categorizes text into sentiments like *Positive*, *Negative*, *Neutral*, and *Mixed*, enabling organizations to understand customer perspectives at scale [1]. This capability removes the need for manual review, allowing faster decision-making and response.

To visualize the processed data, Amazon QuickSight is employed. It provides interactive dashboards that display trends, sentiment scores, and keyword-based filtering. This enables stakeholders to gain business insights quickly and visually from structured results stored in Amazon S3 and queried via Amazon Athena or QuickSight's native data sources [2].

The system is built using a serverless architecture. AWS Lambda functions are triggered automatically when new customer feedback is uploaded to an Amazon S3 bucket. These functions process the input data and invoke Comprehend for sentiment classification. Once processed, the output is stored in another S3 location or a database (such as Amazon DynamoDB), which QuickSight uses as a data source [3].

By taking advantage of event-driven architecture, the system avoids idle computing resources and ensures that users only pay for what they use. It also simplifies scalability, as AWS handles the automatic provisioning of resources under the hood [4].

This architecture is ideal for businesses that need to analyze large volumes of customer feedback across various channels such as online reviews, support tickets, or survey responses. With its serverless nature, the solution is also highly suitable for startups and SMEs operating within the AWS Free Tier [5].

2. AWS SERVICES USED AS PART OF THE PROJECT

To implement AWS Quicksight and comprehend for code reusability, several AWS services have been utilized to ensure a seamless, efficient, and scalable solution. Below are the key AWS services used in the project:

AWS Lambda

AWS Lambda is the compute backbone of the project. It enables running code in response to events, such as a new customer feedback file being uploaded to an S3 bucket. In this project, Lambda performs the following key tasks:

- Triggering Sentiment Analysis: When a new feedback file is uploaded, a Lambda function is triggered to process the file.
- Calling Amazon Comprehend: The function invokes Comprehend APIs to analyze the sentiment of the feedback text.
- Storing Results: The Lambda function then stores the sentiment results in another S3 bucket or a database for further analysis.

This event-driven, stateless architecture ensures fast and scalable processing with no server management required [1].

Amazon Comprehend

Amazon Comprehend is a natural language processing (NLP) service that uses machine learning to extract insights from text. In this system, it is used for:

- Sentiment Analysis: Each piece of feedback is analyzed and categorized as Positive, Negative, Neutral, or Mixed.
- Entity and Key Phrase Extraction *(optional)*: Comprehend can also extract product names, issues, or service terms to provide richer insights.

This step converts unstructured customer feedback into structured, actionable data [2].

Amazon S3 (Simple Storage Service)

Amazon S3 is used as the storage layer of the system. It supports:

- **Storing Raw Feedback**: Customer feedback files are uploaded here (via web form, app, or email parsing).
- **Storing Processed Data**: Results from Comprehend are stored as JSON or CSV files for reporting and visualization.

S3 provides a durable and scalable way to store large volumes of text data and makes it easy to trigger Lambda upon file upload [3].

Amazon QuickSight

Amazon QuickSight is the business intelligence layer of the project. It provides:

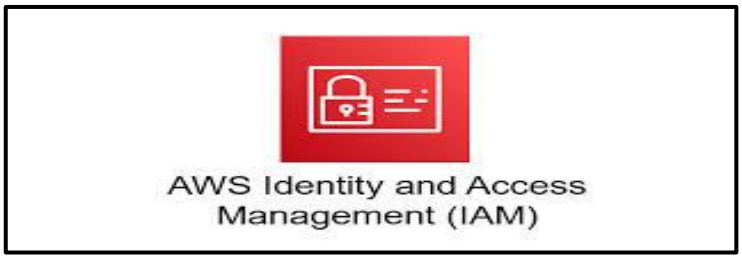
- Dashboards and Reports: Displays sentiment trends, most frequent keywords, or customer satisfaction scores.
- Data Exploration: Users can filter by time, sentiment type, product categories, etc.
- Scheduled Reports: Automatic report generation based on processed data.

QuickSight connects directly to S3 (via QuickSight datasets) to generate dynamic, interactive visuals [4].

AWS IAM (Identity and Access Management)

IAM ensures secure access control across all services. It is used to:

- **Create IAM Roles**: Grant permissions to Lambda functions to access Comprehend, S3, and QuickSight.
- **Manage User Permissions**: Allow only authorized users to manage and deploy services.



3. STEPS INVOLVED IN SOLVING PROJECT PROBLEM STATEMENT

To set up Serverless Customer feedback system:

1.Understand the feedback sources and analysis requirements

- Identify where the customer feedback comes from—emails, surveys, product reviews, or social media.
- Define what insights are required—sentiment analysis, keyword extraction, trend detec-tion, etc.

2.Collect and store feedback in Amazon S3

- Store all raw feedback data (CSV, JSON, or text files) securely in Amazon S3 buckets.
- Organize them by source or time for efficient processing and retrieval.

3.Process data using AWS Lambda and AWS Comprehend

- Set up Lambda functions to trigger on new S3 uploads.
- Use AWS Comprehend to detect sentiment, extract entities, and key phrases from each feedback entry in real time.

4.Store processed data in Aws Lambda and S3

- Save the structured analysis results (like sentiment scores, topics) in queryable formats.
- Use Amazon Glue to create metadata catalogs for easy access from analytics tools.

5.Visualize insights using Amazon QuickSight

- Connect QuickSight to S3 to create dashboards and visual reports.
- Use charts, heatmaps, or trend lines to present customer sentiment and keyword patterns.

6.Secure your solution using IAM and S3 bucket policies

- Apply AWS IAM roles and fine-grained access control to ensure only authorized users or services can access or modify data.

7.Test and iterate the system

- Validate feedback processing accuracy, dashboard performance, and user access controls.
- Refine the models or visualizations based on user feedback and business needs.
- Deploy your serverless customer feedback analytics solution into production

8. Visualizing Processed Feedback Data in QuickSight

- Access Analysis Interface: Upon dataset creation, QuickSight opens an analysis workspace, displaying the available data fields on the left and a visual canvas on the right.
- Select Visual Type: In the "Visuals" pane, choose an appropriate chart type) to represent the desired insights from the feedback data.
- Drag and Drop Data Fields: Drag relevant data fields (e.g., "Sentiment," "ProductCategory," "Rating") from the "Data" pane onto the designated areas of the selected visual (e.g., X-axis, Y-axis, color).
- Customize and Refine: Customize the visual by adjusting colors, labels, filters, and aggregations

4. STEPWISE SCREENSHOTS WITH BRIEF DESCRIPTION

Step 1: Create an S3 Bucket to Store Customer Feedback Data

- Log in to AWS Management Console.
- Search for "S3" and open the Amazon S3 service.
- Navigate to the “General purpose buckets” tab to view or manage your S3 buckets.
- In this example, the bucket named customer-feedback-data-1 is created in the Europe (Stockholm) eu-north-1 region.

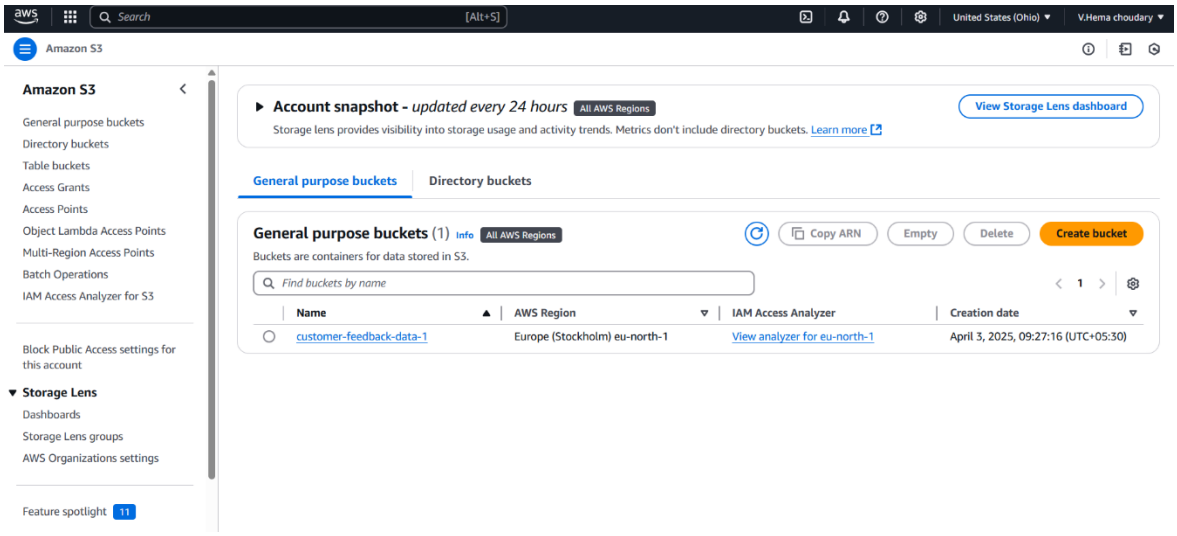


Fig 4.1: Create an S3 Bucket to Store Customer Feedback Data.

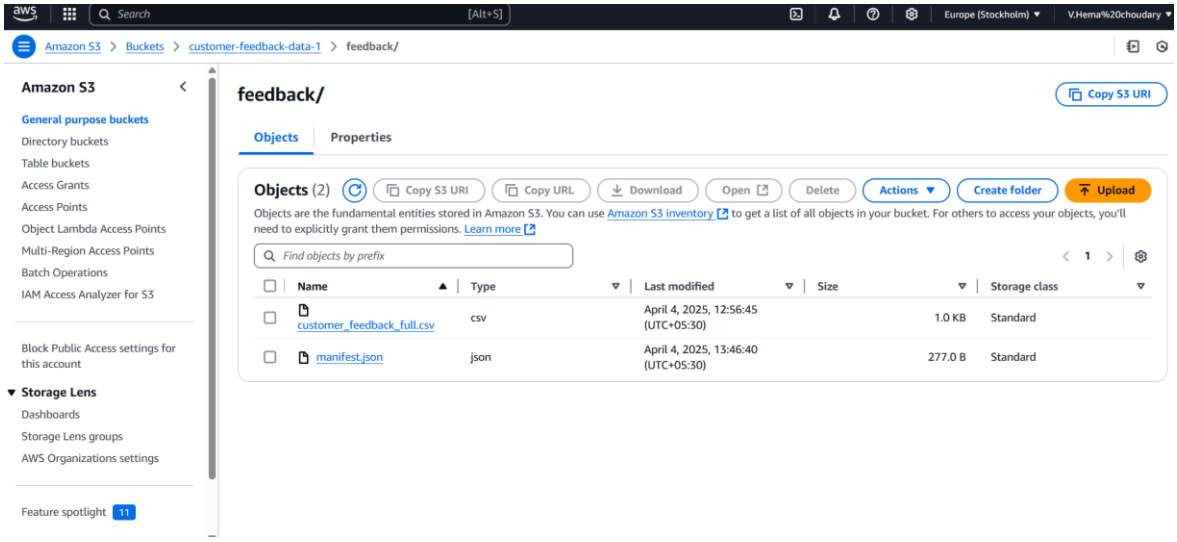


Fig 4.2 : View uploaded files (.csv and .json) inside the S3 bucket folder.

Step 2: Create and Configure a Lambda Function for Sentiment Analysis

- Write Python code to trigger on S3 events, fetch the uploaded CSV file, and use Amazon Comprehend to detect sentiment from each feedback row.

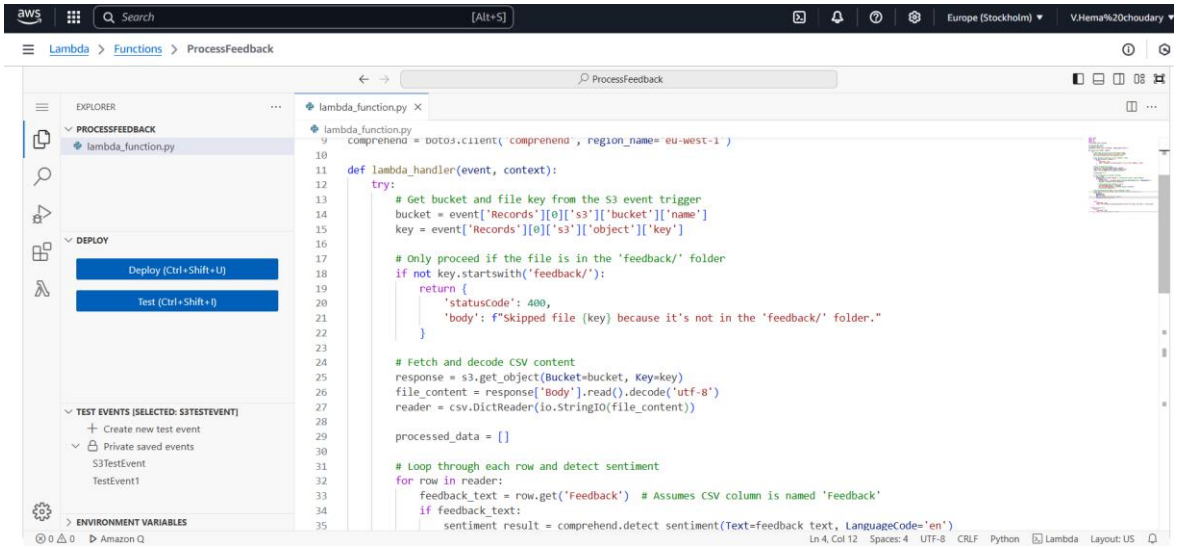


Fig 4.3: Create and Configure a Lambda Function for Sentiment Analysis.

Step 3: Create a Test Event to Simulate S3 Trigger

- Create a test event with your S3 bucket and file path, then click Test to simulate the trigger and validate the function.

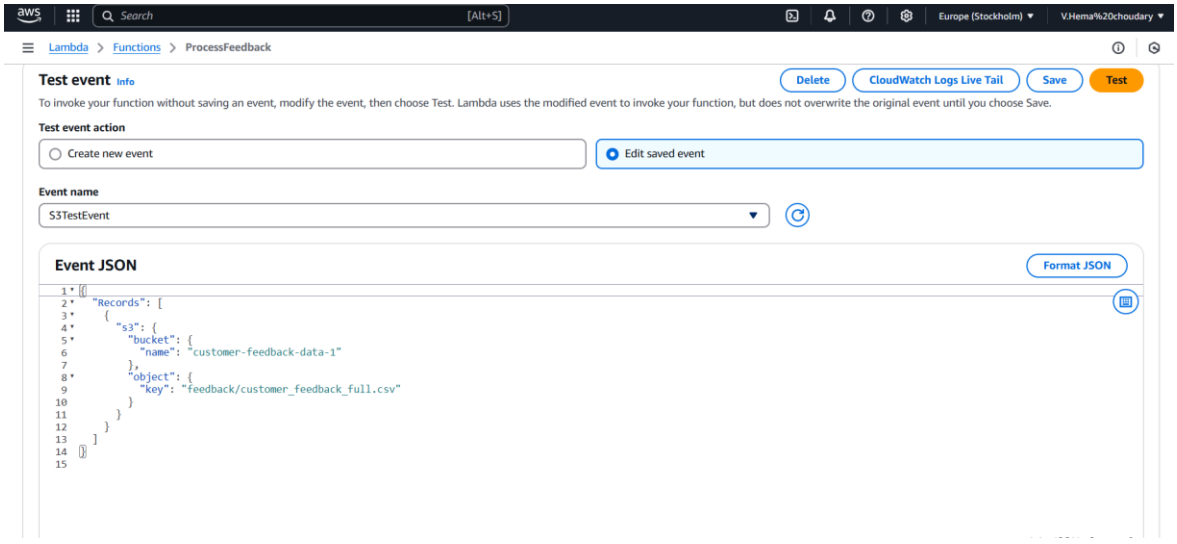


Fig 4.4: Trigger the Lambda Function with S3 Test Event.

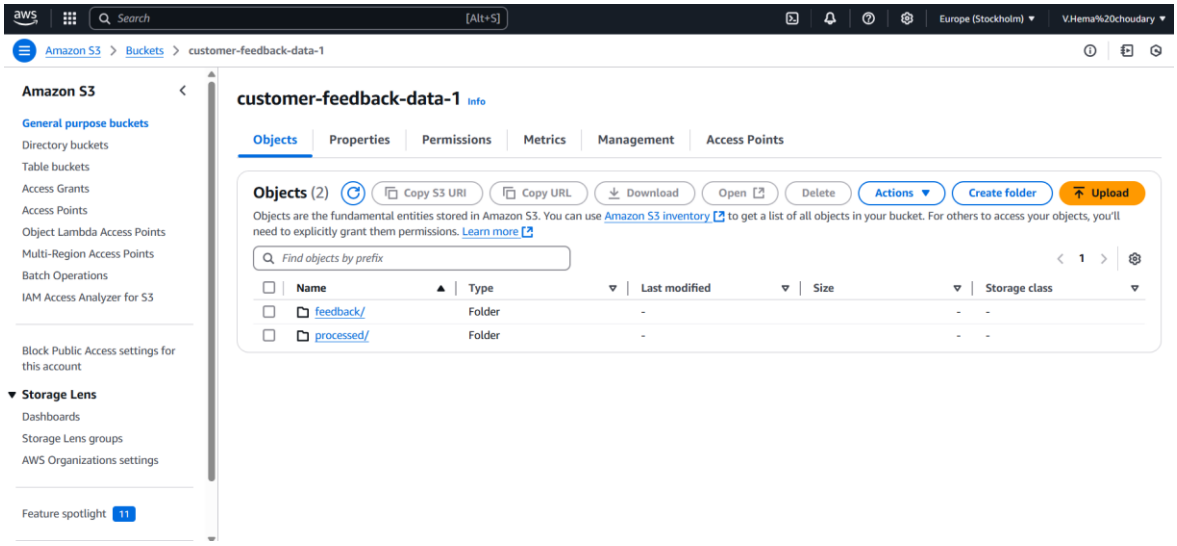


Fig 4.5: the "processed/" folder contains customer feedback data that has been automatically preprocessed.

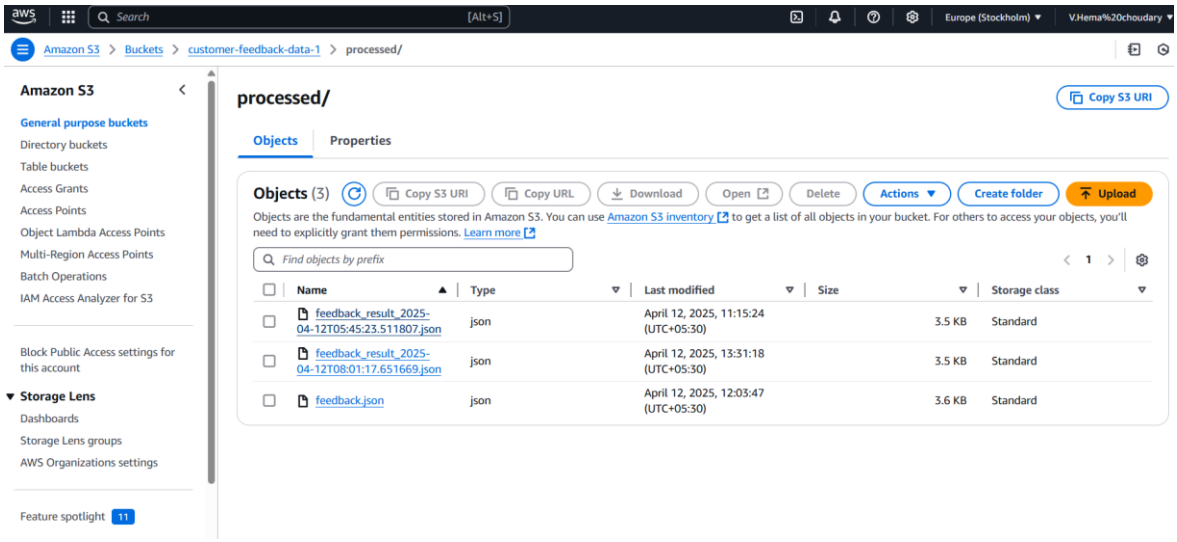


Fig 4.6: Processed feedback data in the Amazon S3 storage.

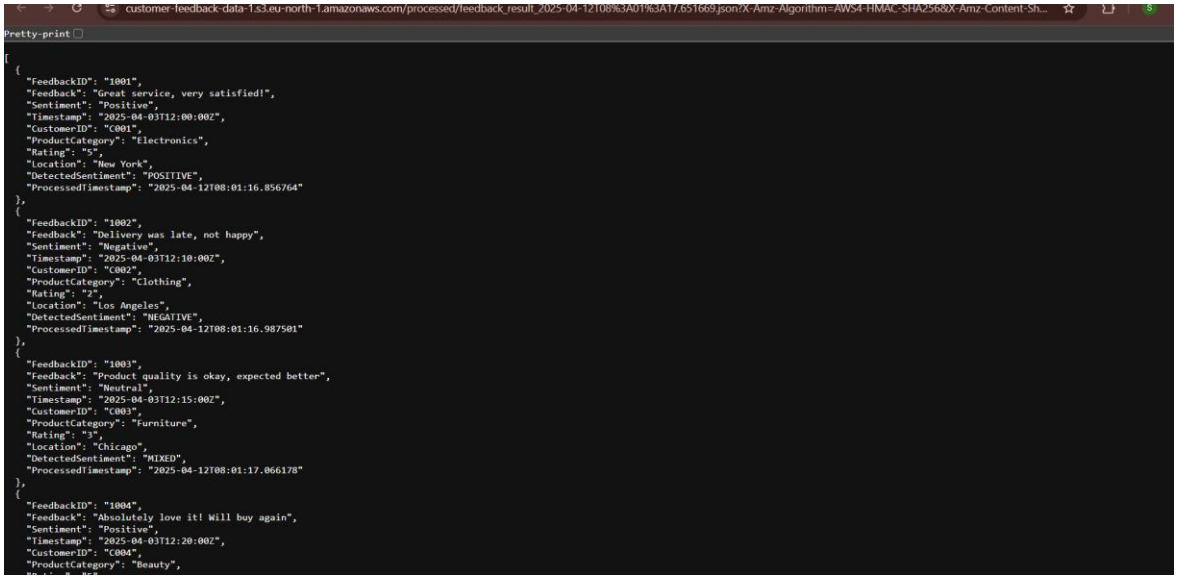


Fig 4.7: displays example processed customer feedback data in JSON format.

Step 4: Enabling Data Visualization with Amazon QuickSight

- Connect QuickSight to S3
- Input the Manifest File URL.
- It will Visualize Processed Feedback

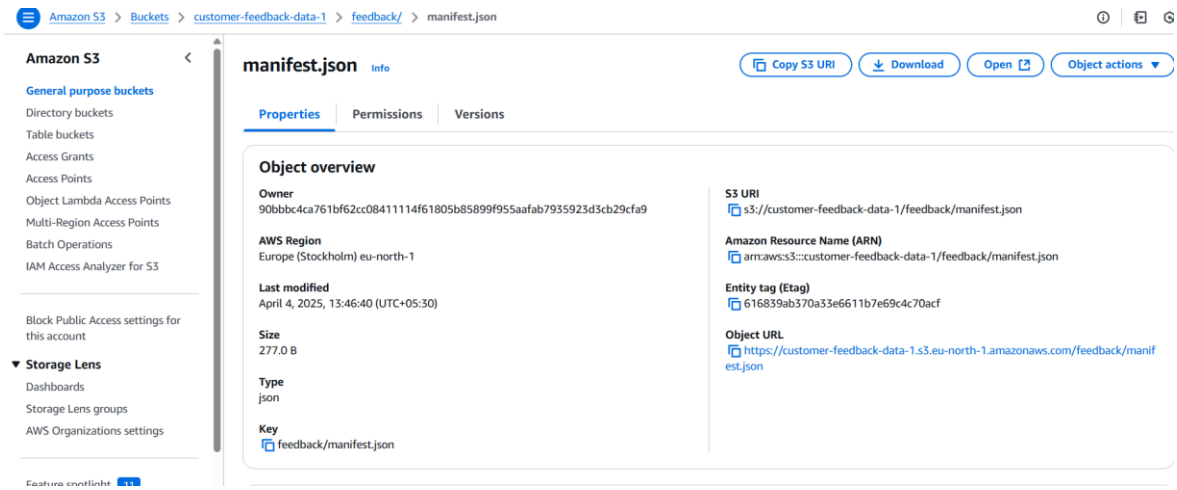


Fig 4.8: Copying the S3 URI from the manifest.json File.

Step 5: Accessing Amazon QuickSight for Data Visualization

- Navigate to AWS Management Console
- Search for QuickSight
- Select QuickSight Service
- Access QuickSight Analyses

Fig 4.9: Navigating to Amazon QuickSight Service.

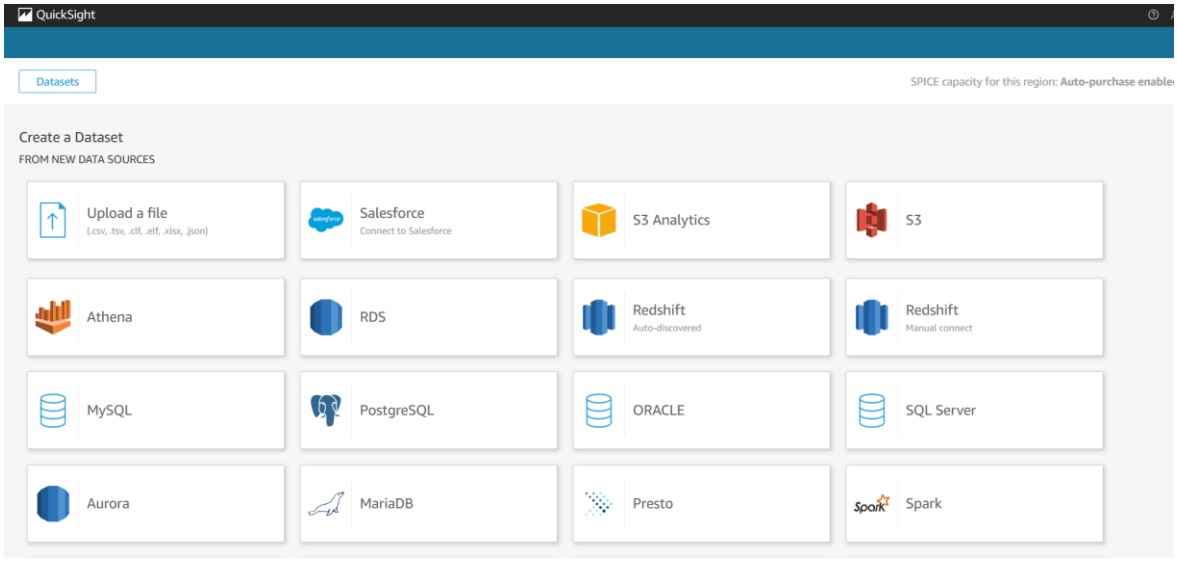


Fig 4.10: Creating a New Dataset in Amazon QuickSight from S3.

Step 6: Connecting to the S3 Manifest File in QuickSight

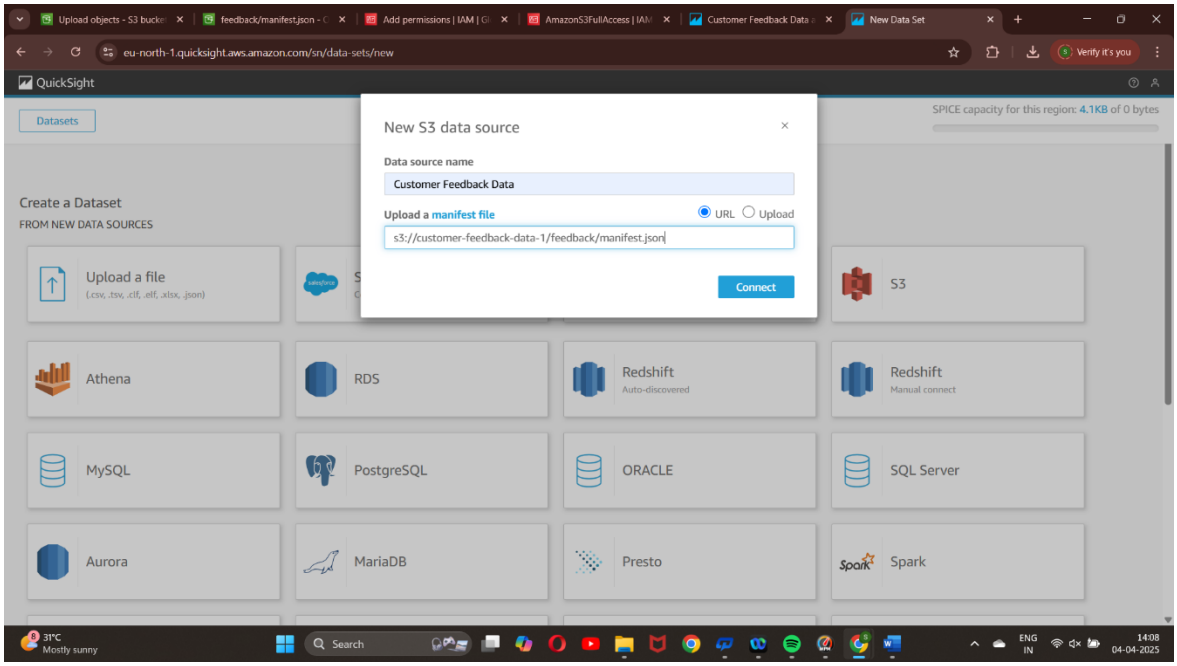


Fig 4.11: Specifying the S3 Manifest for QuickSight Data Source.

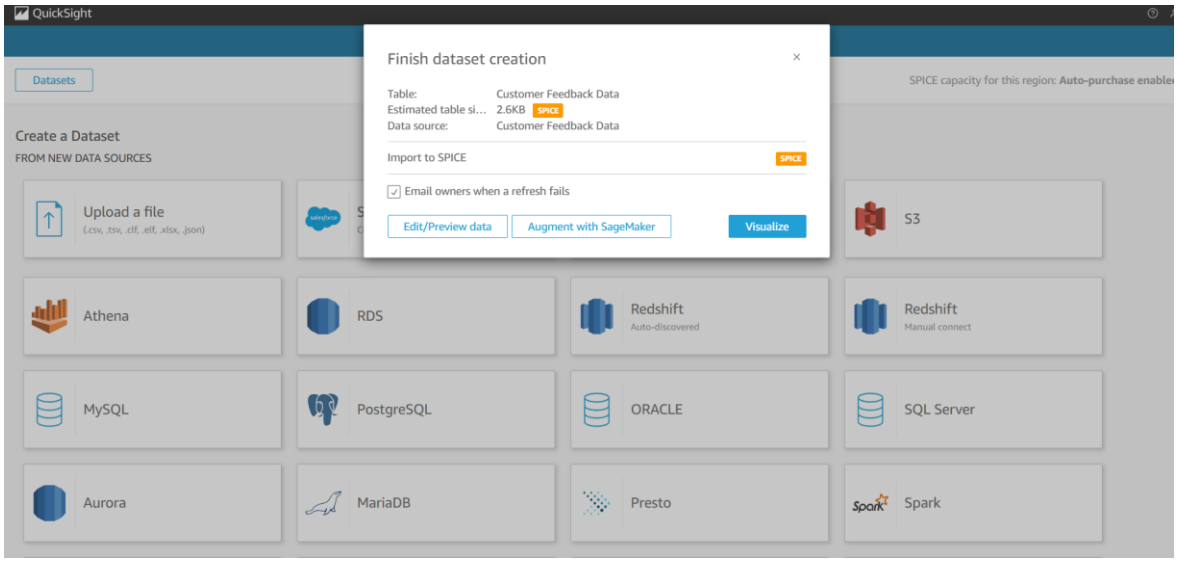


Fig 4.12: Completing the QuickSight Dataset Creation from S3.

Step 7: Visualizing Processed Feedback Data in QuickSight

- Open Analysis Workspace
- Choose Visual Type
- Drag Data Fields
- Customize Visuals using pie chart,bar graphs etc.

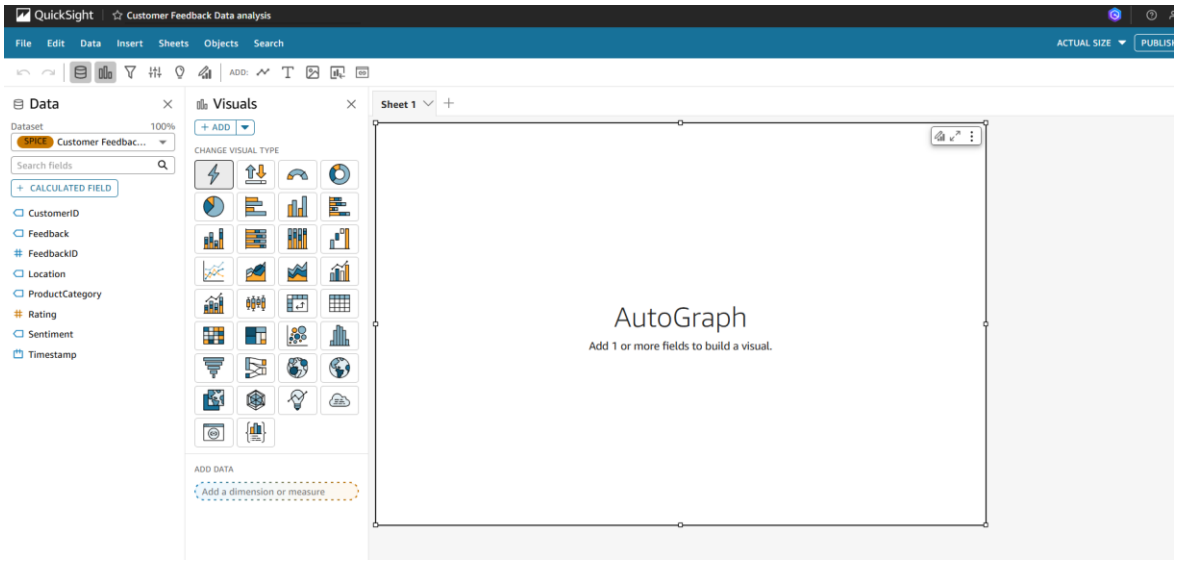


Fig 4.13: QuickSight analysis interface shows feedback data and a selection of visual type.

Step 8: Visualizing Sentiment Distribution with a Pie Chart

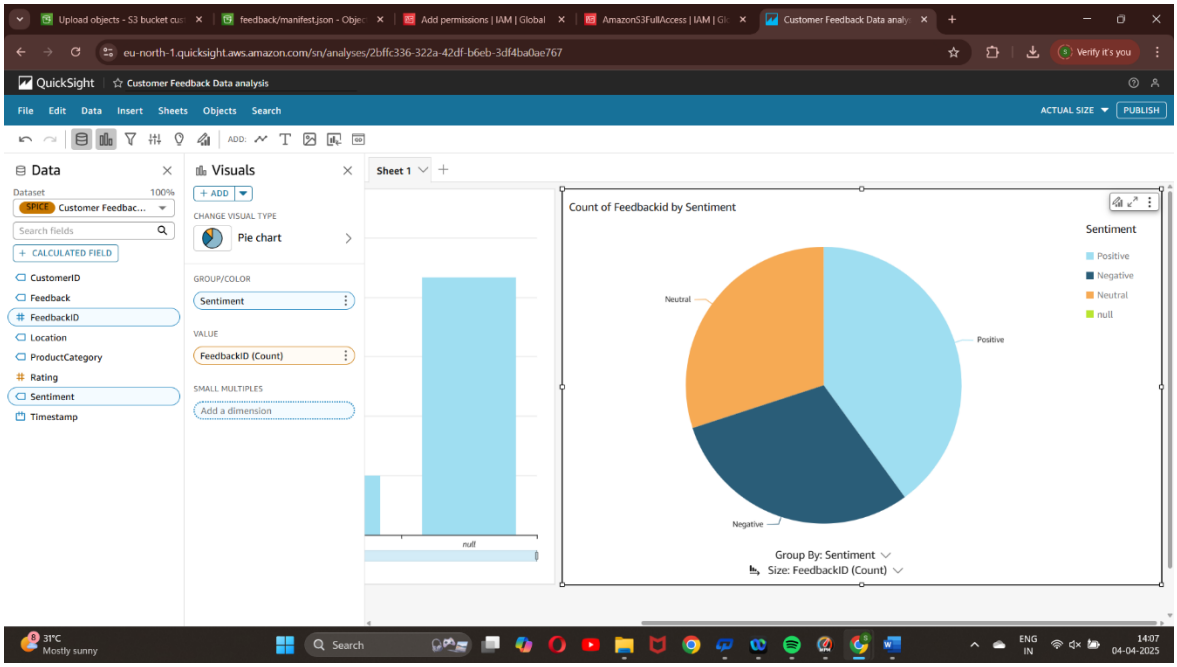


Fig 4.14: A pie chart in QuickSight visualizes the distribution of customer feedback sentiment (Positive, Negative, Neutral, null).

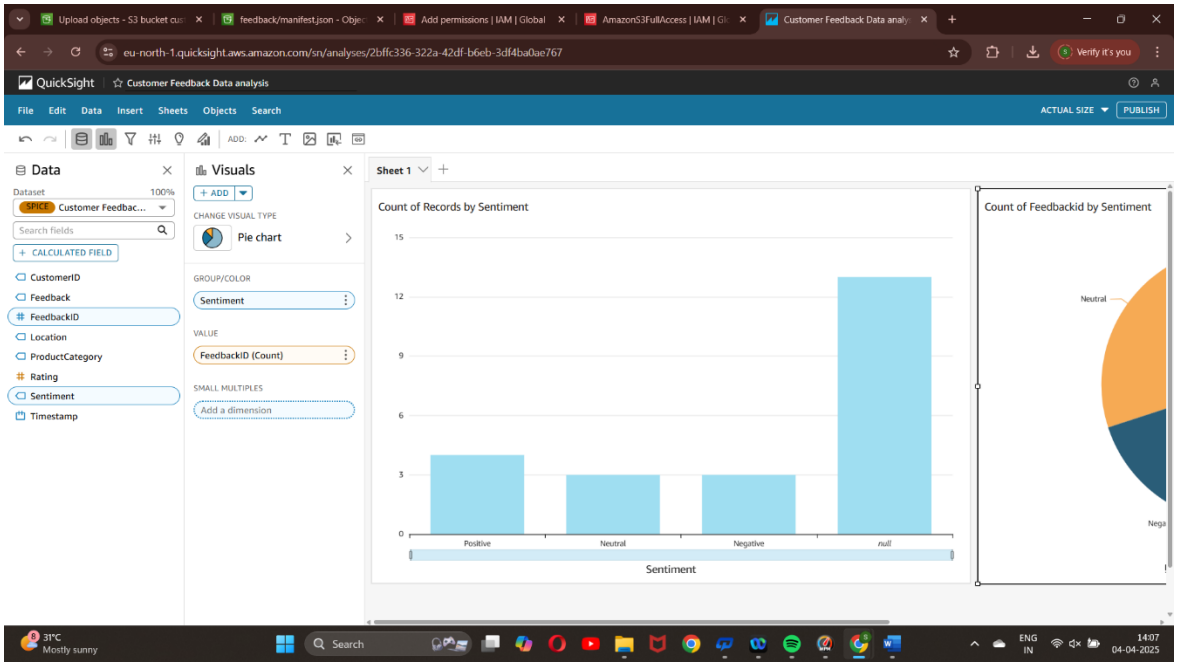


Fig 4.15: A bar graph in QuickSight visualizes the distribution of customer feedback sentiment (Positive, Negative, Neutral, null).

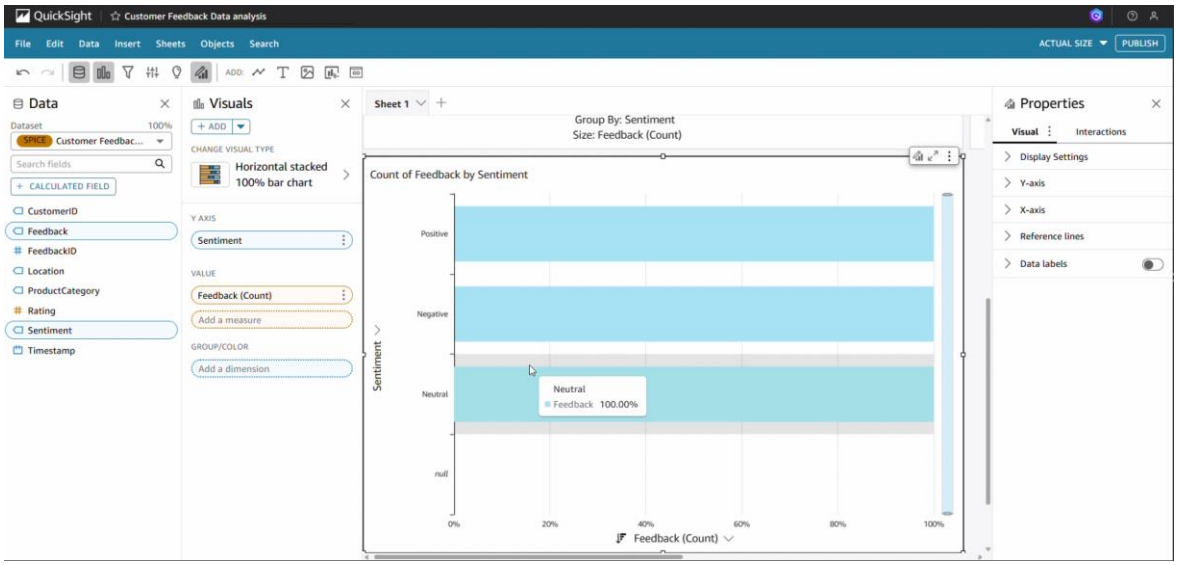


Fig 4.16: A horizontal bar graph in QuickSight visualizes the distribution of customer feedback sentiment (Positive, Negative, Neutral, null).

5. LEARNING OUTCOMES

1.Integration of AWS Services: Explored how different AWS services like S3, IAM, Lambda, Comprehend, and QuickSight can be seamlessly integrated for a fully automated feedback analysis pipeline [4,5].

2. Creating Interactive Data Visualizations: Developed skills in building interactive dashboards and visualizations in QuickSight, including pie charts and bar charts to analyze sentiment trends [6].

3.Optimizing Data Processing with Serverless Architecture: Learned how to integrate AWS Lambda with S3 and Comprehend to automate sentiment analysis on new customer feedback entries in real time [4].

4. Applying Sentiment Analysis with Amazon Comprehend: Understood how to process customer feedback using Amazon Comprehend to categorize sentiment into Positive, Negative, and Neutral labels [3].

5. Connecting S3 Data with QuickSight: Gained practical experience in using manifest files to import structured feedback data from Amazon S3 into QuickSight for analysis [2].

6. Enhancing Security with IAM Policies: Gained insights into setting up IAM roles and permissions to restrict access to S3, Comprehend, and QuickSight, following best security practices [5].

7.Automating Data Refresh in QuickSight: Learned how to schedule and automate dataset refreshes in QuickSight to ensure up-to-date sentiment analysis insights without manual intervention [8].

6. CONCLUSION

The integration of AWS QuickSight and Amazon Comprehend for customer feedback analysis provides a powerful, serverless approach to deriving actionable insights from textual data. By leveraging Amazon S3 for data storage, QuickSight for visualization, and Comprehend for sentiment analysis, organizations can efficiently process and analyze customer feedback without the need for complex infrastructure management. The use of IAM ensures secure access control, while CloudWatch facilitates monitoring and troubleshooting, enhancing the overall reliability of the solution. Additionally, QuickSight's SPICE engine optimizes performance by enabling faster data retrieval and visualization. Automating data refreshes further ensures real-time insights, reducing manual intervention and improving decision-making. This project highlights the benefits of serverless analytics, allowing businesses to scale effortlessly while keeping costs low. As cloud computing advances, the combination of AWS services like QuickSight and Comprehend will continue to be a key enabler in driving data-driven business strategies.

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