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1. Introduction

Email communication remains one of the most widely used and reliable channels for both businesses and individuals. It serves as a primary medium for official correspondence, marketing campaigns, customer engagement, and internal notifications. From large companies to small business, from reaching to employees to clients, email is considered to be the most formal and professional way of communicating. However, it is a time consuming to handle repeating task like sending similar types of emails to 100s and 1000s of clients.

This might sound like a small or a minor problem but from the business point of view it could be the reason for hiring, and making extra expenses. To address these challenges, automation has become a key strategy in modern workflow management. By automating routine email processes, organizations can save significant time, reduce operational costs, and ensure consistency in communication. Automation also enhances reliability by minimizing the risk of missed messages or incorrect information, while allowing employees to focus on higher-value tasks.

This project leverages **n8n**, an open-source workflow automation tool, to design and deploy an **Email Automation System**. n8n provides a flexible, node-based interface that enables integration with multiple services such as Gmail, Google Sheets, and APIs. Through this system, emails can be triggered by specific events, scheduled at regular intervals, or personalized based on dynamic data sources.

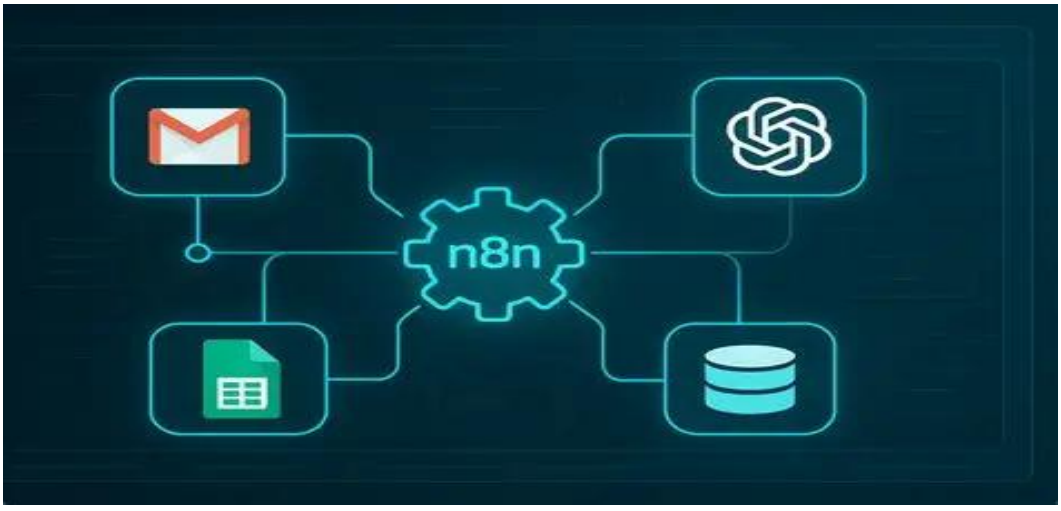

Figure 1: N8N Config

1.1 Problem Statement

In this age of automation and artificial intelligence, having updated clients who knows about the offers and schemes ongoing in a business and keeping the employees updated about the work status and all is key. Since email is a most formal way of communication, it is most for a company to have each and every communication via email. But having 100s of clients and employees and sending them mails manually is a very time-consuming task. There automation is what a company need.

Some of the problem statements are mentioned below:

- Time Consuming
- Human Error
- Scalability
- Lack of Personalization
- Monitoring and Reliability

1.2 Project as Solution

It is very important to overcome the inefficiencies of manual handling so that the project proposes the design and deployment od **Email Automation System** using **n8n.** The solution leverages n8n's node-based workflow automation capabilities to integrate the google sheets, gmail, and other functionalities.

The system will work as a solution to the problem statements in the following ways:

- Time Efficiency
- Error Reduction
- Scalability
- Personalization

2. Aims and Objectives

2.1 Aim

The aim of the project is to develop a reliable automation system for "**Tanvitech Pvt. Ltd.**", capable for sending emails to the clients or employees of the company. The system helps ease the communication system of the Tanvi Tech by leveraging its efficiency.

2.2 Objectives

The objectives of the "Email Automation System" developed for the Tanvi Tech are mentioned below:

- To automate the email sending system
- To Reduce the resources and cost in manual labor.
- To enhance the personalization.
- To support monitoring and transparency.

3. System Design

3.1 Tools and Technologies

- **n8n**: Open-source workflow automation platform.
- **Google Sheets**: Used as a dynamic data source for recipient details.
- **Gmail**: Email service provider for sending automated emails.
- **Docker**: Deployment environment for hosting n8n.
- **Version Control (GitHub)**: For workflow storage and documentation.

3.2 Workflow Architecture

The system is designed as a sequence of interconnected nodes in n8n:

1. **Trigger Node** – Initiates workflow based on a schedule (Cron job) or event (new entry in Google Sheets).
2. **Data Source Node** – Fetches recipient details and message content dynamically.
3. **Email Node** – Sends personalized emails using Gmail integration.
4. **Notification Node** – Alerts admin via Slack/Telegram if workflow fails.

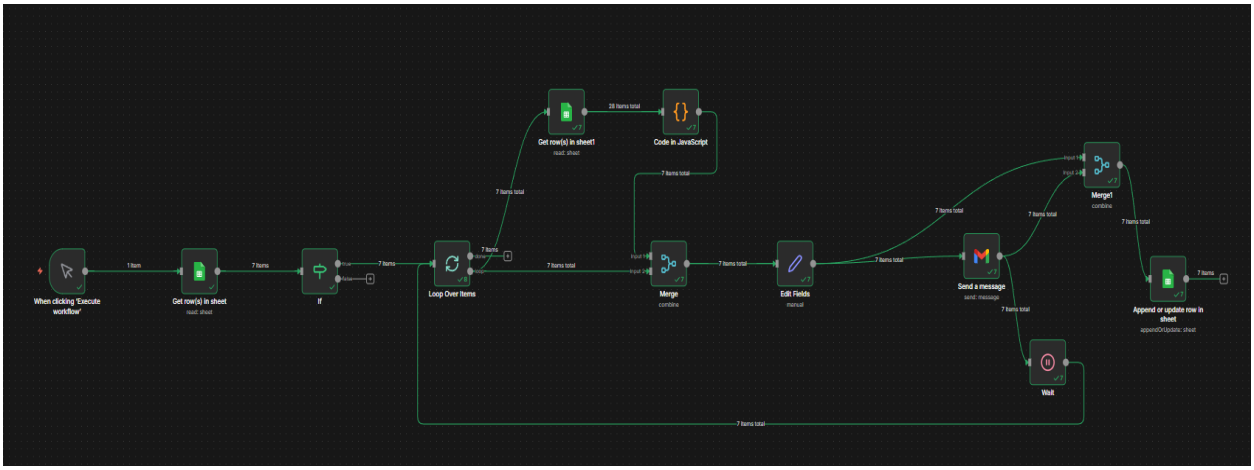

Figure 2: Workflow of the system

3.3 Implementation Steps

• **Setup Environment**: Installed n8n locally or via Docker. Configured environment variables for Gmail/SMTP.

• **Workflow Design**: Created nodes for triggers, data sources, and email sending.

• **Testing**: Verified with sample recipients and monitored error handling.

• **Deployment**: Hosted workflow on n8n server and scheduled automation for daily/weekly execution.

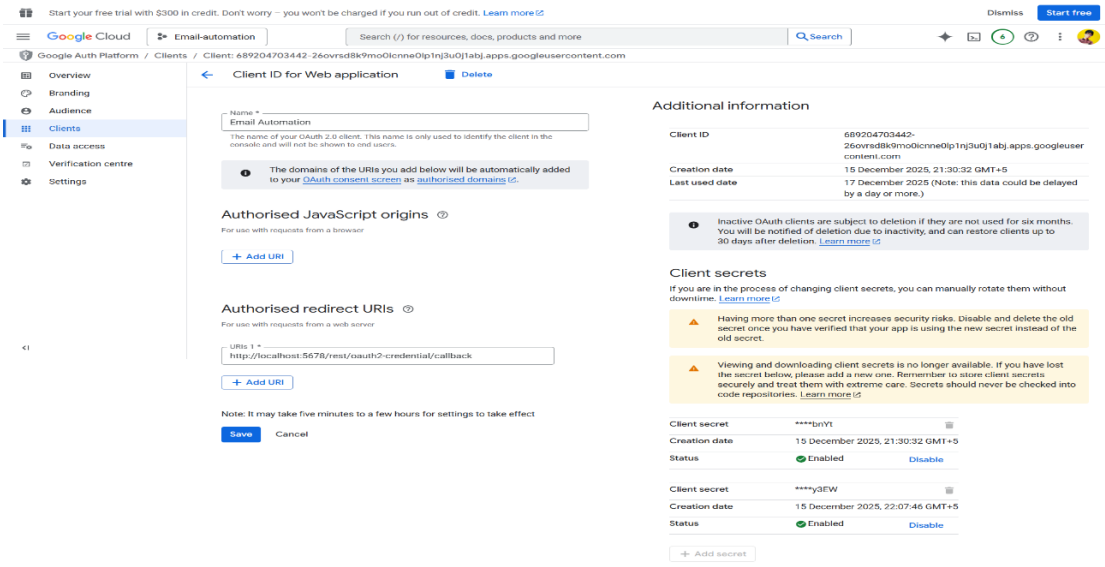

Figure 3: Setting up Client ID and Secret Key

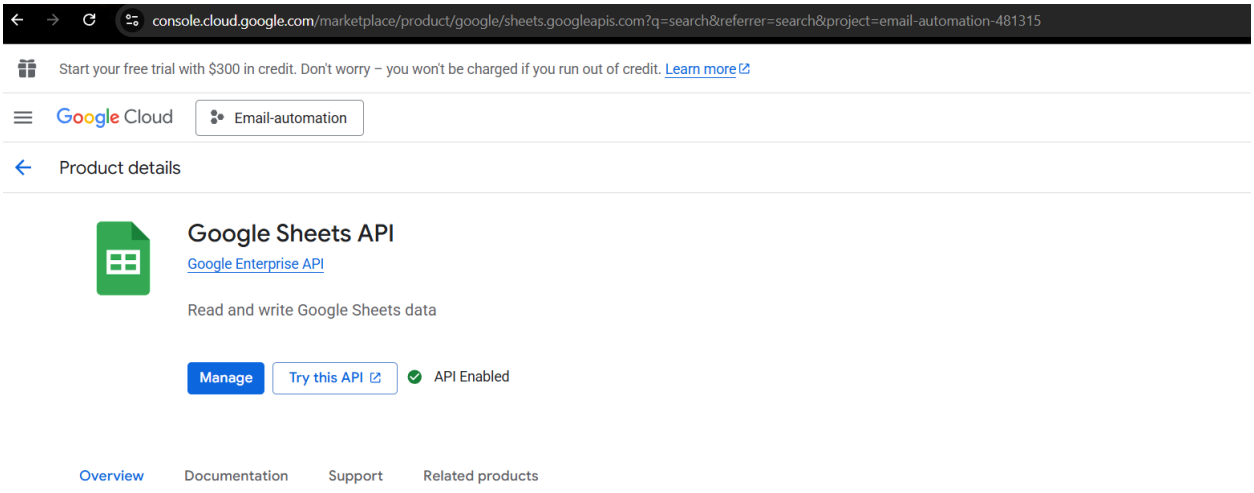

Figure 4: Enabling Google Sheets API

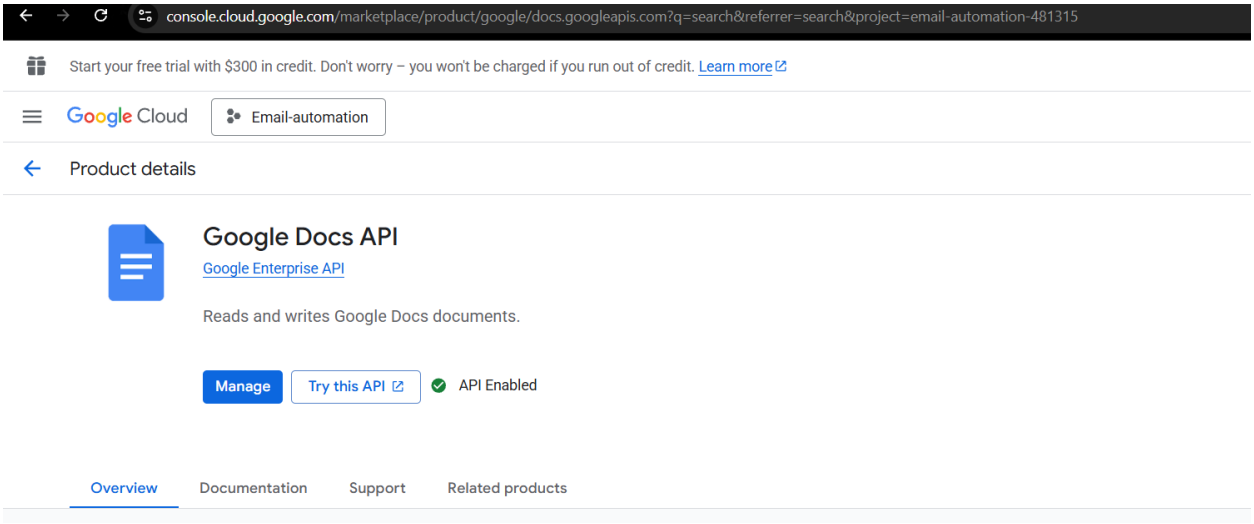

Figure 5: Enabling Google DOCs API

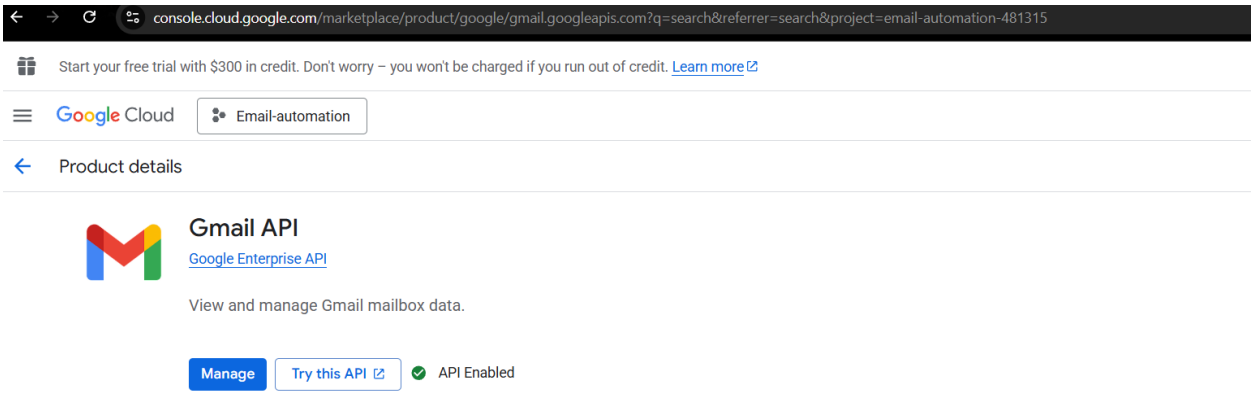

Figure 6: Enabling Gmail API

4. Flowchart

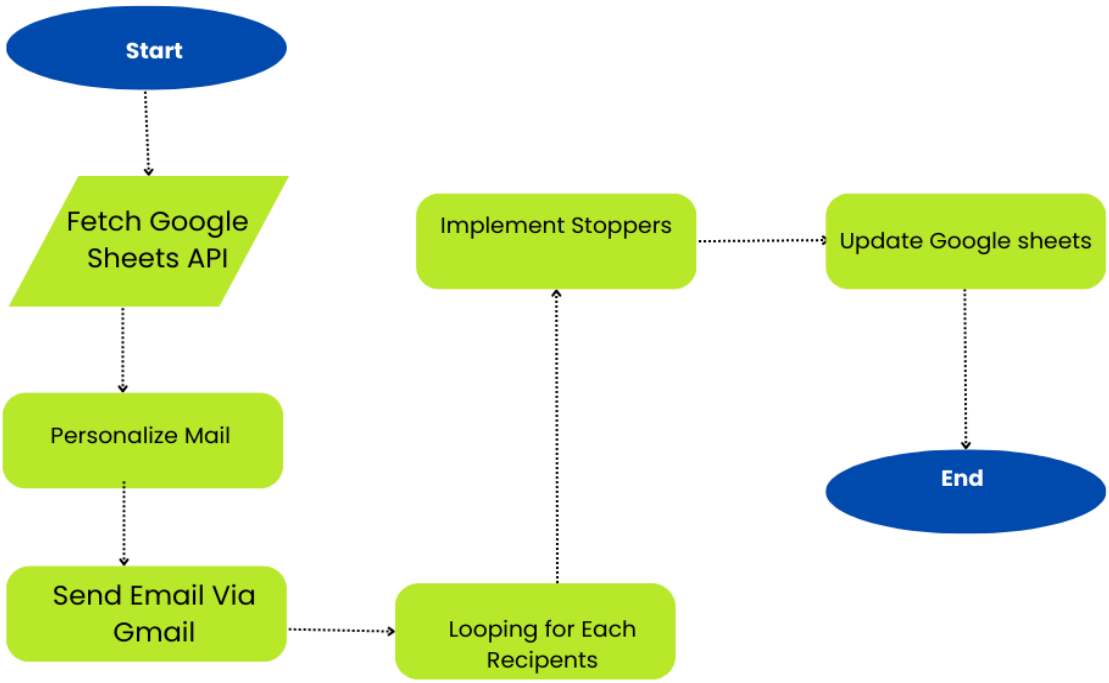

Figure 7: Flowchart of the system

5. Results and Discussion

- Automated sending of emails without manual intervention.
- Reduced human error and improved consistency.
- Achieved significant time savings compared to manual processes.
- Workflow proved scalable for handling large recipient lists.

6. Challenges and Solutions

- **Authentication Issues**: Resolved using OAuth2 for Gmail API.
- **Error Handling**: Implemented retry logic and logging nodes.
- **Scalability**: Designed modular workflows for easy extension.
- **Data Privacy**: Secured credentials using environment variables.

7. Testing

Test Type	Scenario	Expected Outcome	Result
Functional Testing	Trigger workflow via Cron job and Google Sheets update.	Emails should be sent automatically to all valid recipients.	Success
	Verify personalization placeholders (e.g., recipient name, subject line).	Placeholders replaced correctly in email body and subject.	Success
Error Handling	Input invalid email addresses.	System should log failure, retry sending, and notify admin.	Success
	Simulate server downtime.	Workflow should retry after delay and log error.	Success
Performance Testing	Send emails to 100+ recipients simultaneously.	Workflow should scale without delays or bottlenecks.	Success
	Measure execution time for large batches.	Execution time remains within acceptable limits.	Success
Integration Testing	Connect n8n with Gmail and Google Sheets.	Authentication works consistently; data flows correctly between services.	Success
	Test OAuth2 authentication for Gmail API.	Secure login and token refresh handled correctly.	Success

Table 1: Testing

8. Conclusion

This project demonstrates how workflow automation with n8n can transform repetitive email tasks into efficient, reliable, and scalable processes. By integrating triggers, data sources, and email services, the system reduces manual workload, improves communication consistency, and lays the foundation for advanced automation in business environments. This project highlights the practical benefits of automation in a business environment. For **Tanvi Tech Pvt. Ltd.**, the system reduces operational costs by minimizing the need for manual labor, while simultaneously improving efficiency and consistency in communication. The ability to personalize emails dynamically enhances engagement with recipients, making communication more effective and professional. Furthermore, the inclusion of error handling and monitoring mechanisms ensures that the system remains dependable, even when scaled to handle large volumes of emails.