A Mini Project Report on

"CEA-COLD EMAIL AGENT"

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CERTIFICATE

This is to certify that the project work entitled **"COLD EMAIL AGENT"** is a bona fide work carried out by students **ARAVIND PAWAR (1SZ23CS006), ARUN KUMAR K H (1SZ23CS009), CHANDAN R (1SZ23CS014), NAVEEN KUMAR (1SZ23CS037),** of Sampoorna institute of technology and research College of Engineering in partial fulfilment for the award of Bachelor of Engineering in Computer Science and Engineering of the Visvesvaraya Technological University, Belagavi during the year 2025-2026. It is certified that all the corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The project report has been approved as it satisfies the academic requirements in respect to the technical part prescribed for the above said degree.

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ABSTRACT

- Cold emailing continues to be one of the most commonly used methods for business outreach, marketing campaigns, corporate communication, and academic coordination. However, manually drafting personalized email content, verifying recipient details, and sending messages to large groups leads to increased workload, inconsistency, and significant time consumption. To address these challenges, this project develops an **AI-Powered Cold Email Agent**, an automated and intelligent system designed to generate, personalize, schedule, and deliver cold emails with minimal human intervention.
- The proposed system integrates **Artificial Intelligence**, **Natural Language Processing**, and **workflow automation** to produce high-quality, context-aware email content tailored to each recipient. Using NLP- based models, the agent automatically generates personalized subject lines, email bodies, call-to-action sentences, and signature blocks based on the user's requirements. The workflow leverages **n8n**, a powerful open-source automation tool, which connects email services, AI agents, spreadsheets, databases, and SMTP servers to create a fully automated pipeline.
- The Cold Email Agent extracts recipient information from sources such as **Google Sheets, CSV files, or databases**, validates email formats, identifies missing fields, and dynamically fills template variables. It then generates personalized messages using AI and sends them through the configured SMTP service. The system supports scheduling, bulk sending, throttling to prevent spam classification, and automated follow-ups based on user-defined conditions.
- Furthermore, the agent maintains a **real-time email log**, including sent status, timestamps, message IDs, thread IDs, and label classification (Inbox, Sent, Important). It also supports analytics for measuring open rate, delivery accuracy, and response effectiveness. The modular design allows easy integration with CRMs, lead-generation tools, WhatsApp, Telegram, and other communication channels.
- This project demonstrates how AI and automation can significantly reduce manual effort, improve accuracy, and deliver consistent quality in large-scale email communication. The Cold Email Agent is scalable, cost-effective, and suitable for use in corporate environments, educational institutions, digital marketing teams, and startup outreach campaigns. Overall, the system represents a practical and innovative solution for modern email automation, aligning with the current industry demand for intelligent communication tools.

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CHAPTER 1

INTRODUCTION

Email remains one of the most powerful and reliable communication channels used in business, education, marketing, customer relationship management, and professional networking. With the rapid growth of digital interactions, organizations increasingly rely on automated systems to manage large-scale communication tasks. Among these, **cold emailing**—the process of reaching out to new, unacquainted recipients for marketing, outreach, or information exchange—plays a crucial role in modern workflows. However, crafting personalized cold emails manually for hundreds or thousands of recipients is both time-consuming and prone to errors.

To address this challenge, the **Cold Email Agent** project introduces an intelligent automation system capable of generating, personalizing, and sending cold emails with minimal human effort. This system leverages **Artificial Intelligence (AI)** and **workflow automation platforms** such as **n8n**, along with **SMTP email services**, to streamline the entire cold email process. By integrating Natural Language Processing (NLP), data validation techniques, and dynamic template management, the system ensures high-quality, human-like email content tailored to each recipient.

1.1 PROBLEM STATEMENT

Organizations and individuals spend significant time drafting, personalizing, and sending cold emails manually. This repetitive process results in inconsistent messaging, delays, and low productivity. Managing recipient data, generating professional emails, validating email formats, and tracking delivery status becomes difficult without automation.

A Cold Email Agent is needed to automate email creation, personalization, validation, and bulk sending while ensuring accuracy, efficiency, and improved communication. The system should generate context-relevant emails using AI, handle large recipient lists, reduce manual effort, and maintain proper logs of email delivery.

Therefore, there is a need for an **automated Cold Email Agent** that can generate personalized, professional emails, validate recipient data, manage templates, reduce manual effort, and improve efficiency. The system should integrate with email services, automate sending, ensure deliverability, and help users handle bulk outreach with accuracy and consistency.

1.2 OBJECTIVES OF THE PROJECT

- **To improve email personalization** through intelligent data extraction from spreadsheets, CRM systems, or user inputs.
- **To enhance email deliverability** by integrating SMTP/Gmail APIs to ensure emails reach inboxes instead of spam folders.
- **To provide real-time tracking and analytics** for open rates, click rates, bounce rates, and reply monitoring.
- **To reduce manual errors** by automating template selection, subject generation, grammar correction, and formatting.
- **To support multiple cold email templates** (sales, marketing, job outreach, client acquisition, partnerships, etc.) for flexible usage.
- **To allow bulk email sending** while maintaining unique, personalized content for each recipient.
- **To integrate with external platforms** (Google Sheets, Notion, CRM tools, or n8n workflows) to enable fully automated cold-email pipelines.

1.3 EXISTING SYSTEM

- **Manual Email Writing Tools** Users draft messages using standard email platforms such as Gmail or Outlook. Although these platforms provide formatting options, they lack automation, AI-driven personalization, or bulk sending capabilities.
- **Basic Email Marketing Tools** Some tools like Mailchimp and Sending blue support campaign creation, but they still require predefined templates and do not automatically personalize emails for each recipient. They also do not integrate seamlessly with custom workflows, CRMs, or n8n automation systems.
- **CRM-Based Email Sending** CRMs like HubSpot or Zoho allow sending emails to contacts, but they are mostly used for follow-ups, not cold outreach. Personalization features are limited and often require manual setup.
- **Spreadsheet-Based Management** Many users maintain lead lists in Excel or Google Sheets. Tracking the status of sent emails, replies, or follow-ups is done manually, which reduces accuracy and efficiency.

1.4 PROPOSED SYSTEM

- Cold email outreach is currently performed manually, making the process slow and inefficient for individuals and organizations.
- Users must write each email separately, which increases workload and reduces productivity when dealing with large lead lists.
- Existing email systems offer limited personalization, resulting in generic emails that receive low response and engagement rates.
- Managing recipient information through spreadsheets or CRMs requires manual updates, leading to human errors and inconsistencies.
- Tracking sent emails, open rates, replies, and follow-ups is difficult without automated analytics tools.
- Many cold emails land in spam due to improper formatting, missing metadata, or unoptimized sending practices.
- Existing automation tools do not provide AI-generated email content or dynamic customization based on user data.
- Lack of integration with external platforms (Google Sheets, CRMs, n8n workflows) creates gaps in a smooth end-to-end email pipeline.
- Bulk email sending becomes complex without an automated system that ensures each email remains personalized.
- Users face challenges maintaining consistency, quality, and accuracy in large-scale outreach campaigns without intelligent automation.

CHAPTER 2

LITERATURE SURVEY

R. Sharma et al., IJERT, 2023 AI-Powered Cold Email Personalization

This study introduces an AI-based model that personalizes cold email content using attributes such as name, industry, and user behavior. The system applies NLP techniques to improve tone, subject lines, and message relevance. It achieves better engagement when compared to traditional static templates. However, it still depends heavily on pre-defined structures that limit flexibility. Therefore, it is not capable of supporting large-scale automated cold outreach.

N. Prasad & A. Rao, IRJET, 2024 Automated Email Marketing Framework

This research presents a rule-based email automation framework designed for marketing workflows and newsletter scheduling. It improves overall communication efficiency by sending timely messages based on customer activity. However, the system cannot generate personalized cold email content dynamically. Its functionality remains restricted to fixed rule-driven templates. Thus, it is ineffective for large-scale cold email personalization.

Liang Wu et al., IEEE Access, 2025 NLP-Based Professional Email Generator

The authors developed an NLG model capable of drafting well-structured and grammatically correct professional emails. It enhances writing quality using advanced NLP techniques. However, the system lacks features such as lead integration, analytics, and deliverability optimization. Its purpose remains limited strictly to content creation. Therefore, it does not fulfill the requirements of a complete cold email automation system.

S. Mehta & R. Kulkarni, IJCA, 2023 Gmail API Workflow Automation

This study automates email scheduling and sending through Gmail API functions, reducing repetitive manual work. It efficiently handles formatting, attachments, and predefined template-based messages. However, it does not include AI-driven personalization or dynamic content creation. The automation is limited to delivery workflows rather than intelligent outreach. Hence, the system is not suitable for personalized cold email campaigns.

David L. & Simon K., Springer, 2024 Sales Outreach Assistance System

This system provides a semi-automated assistant that generates basic template-based sales outreach emails. It helps reduce effort for repetitive sales communication tasks. However, personalization is minimal and largely rule-based, lacking contextual intelligence. The system cannot scale effectively when handling large lead lists. Thus, it is not a practical solution for professional cold email outreach.

Ritika Singh et al., IJCSIT, 2024 Predictive Email Response Analyzer

This study introduces a machine learning model that predicts the likelihood of receiving responses to emails. It analyzes user interaction patterns and past behaviors to guide follow-up decisions. However, the system does not generate or send emails automatically. Its functionality is limited to analytics rather than comprehensive automation. Therefore, it is insufficient for end-to-end cold email outreach.

T. Johnson & M. Patel, Elsevier, 2023 CRM Email Automation Integration

The research integrates automated email reminders and follow-up workflows into existing CRM systems to improve customer engagement. It streamlines communication within sales pipelines. However, it lacks AI-driven personalization and dynamic message generation. The system cannot handle large-scale cold email campaigns with individual customization. Hence, it does not meet the requirements of advanced cold outreach systems.

H. Ramesh et al., IJRASET, 2025 Intelligent Campaign Management Tool

This study presents a system that automates marketing email campaigns while tracking user engagement metrics. It organizes communication effectively through scheduled workflows. However, it depends entirely on static templates and lacks AI-generated personalization. The absence of dynamic content reduces the impact of outreach messages. Therefore, it is unsuitable for targeted cold email operations.

A. Shah & S. Fernandes, IEEE, 2024 Conversational AI for Business Communication

The authors explore conversational AI tools designed to assist users in drafting and improving business emails. The system enhances clarity, tone, and professionalism in written communication. However, it does not support bulk outreach or automated cold email generation. Its primary function is to assist rather than automate communication.

K. Prakash et al., IRJCS, 2025 Web-Based Lead Extraction and Enrichment System

This research proposes a system for extracting and enriching lead data from various online sources. It helps users gather detailed information useful for outreach planning. However, it does not integrate with email generation or automated sending tools. The system only supports the data collection stage of the outreach process. Therefore, it cannot perform complete cold email tasks.

S. Yadav & P. Rani, IJSDR, 2023 Scalable Bulk Email Distribution Framework

The authors develop a scalable framework capable of sending high volumes of emails efficiently. It works well for organizational announcements and mass communication. However, the messages produced are generic and lack personalization. This reduces engagement rates significantly during outreach attempts. Hence, the system is not ideal for cold email campaigns.

George E. & Ali H., ACM, 2024 NLP-Enhanced Writing Assistant

This tool uses NLP to improve tone, grammar, and clarity in professional emails. It enhances the overall writing quality through intelligent rewriting techniques. However, it requires manual input and cannot generate personalized cold emails. The system provides editing assistance rather than automation. Thus, it cannot be used for large-scale cold email outreach.

Compiled, 2025 Identified Gap in Literature

Across all reviewed studies, no system provides a complete end-to-end cold email automation solution. Existing tools focus individually on writing, scheduling, analytics, or personalization without combining them. None integrate AI-driven content generation with workflow automation and bulk sending. This creates a clear technological gap in modern outreach systems. Therefore, a comprehensive AI-based Cold Email Agent is necessary to address this gap.

CHAPTER 3

DESIGN AND ARCHITECTURE

3.1 DATAFLOW DIAGRAM

3.1.1 Level -0 DFD

A Level 0 DFD, also known as a Context Diagram, is the highest-level representation of the Cold Email Agent system. It shows the entire Cold Email Agent as a single process and identifies the external entities that interact with it, along with the data exchanged between them. The purpose of this diagram is to illustrate how the system fits within its environment without describing internal mechanisms or subprocesses. The Cold Email Agent is a software system that automates the creation, personalization, sending, and tracking of cold emails using AI and backend integrations such as Gmail API, SMTP servers, and Google Sheets.

It typically includes functionalities like:

- Generating personalized cold email content using AI
- Sending emails via Gmail/SMTP automatically
- Reading and updating lead details from Google Sheets or databases
- Tracking email status such as sent, delivered, opened, and replied
- Managing templates, follow-ups, and email logs.

At the Level 0 DFD, we represent this entire functionality as a single high-level process called

“Cold Email Agent System.”

This diagram serves as the foundation for more detailed diagrams (such as Level 1 and Level 2 DFDs), which break the internal system into smaller processes like “Generate Email Content,” “Send Email,” “Track Responses,” and “Update Lead Sheet.” It clearly shows the system’s boundaries — what's inside (the Cold Email Agent automation module) and what's outside (User, Gmail Server, Google Sheets, and Lead Database). It provides a simple overview of how the entire system operates without going into technical complexities.

It shows the whole Cold Email Agent as a single process and identifies the external entities interacting with it, the kinds of data flowing into and out of the system, and the types of operations being exchanged. The main objective of a Level 0 DFD is to present the overall system structure and its interaction environment without explaining internal operations or logic.

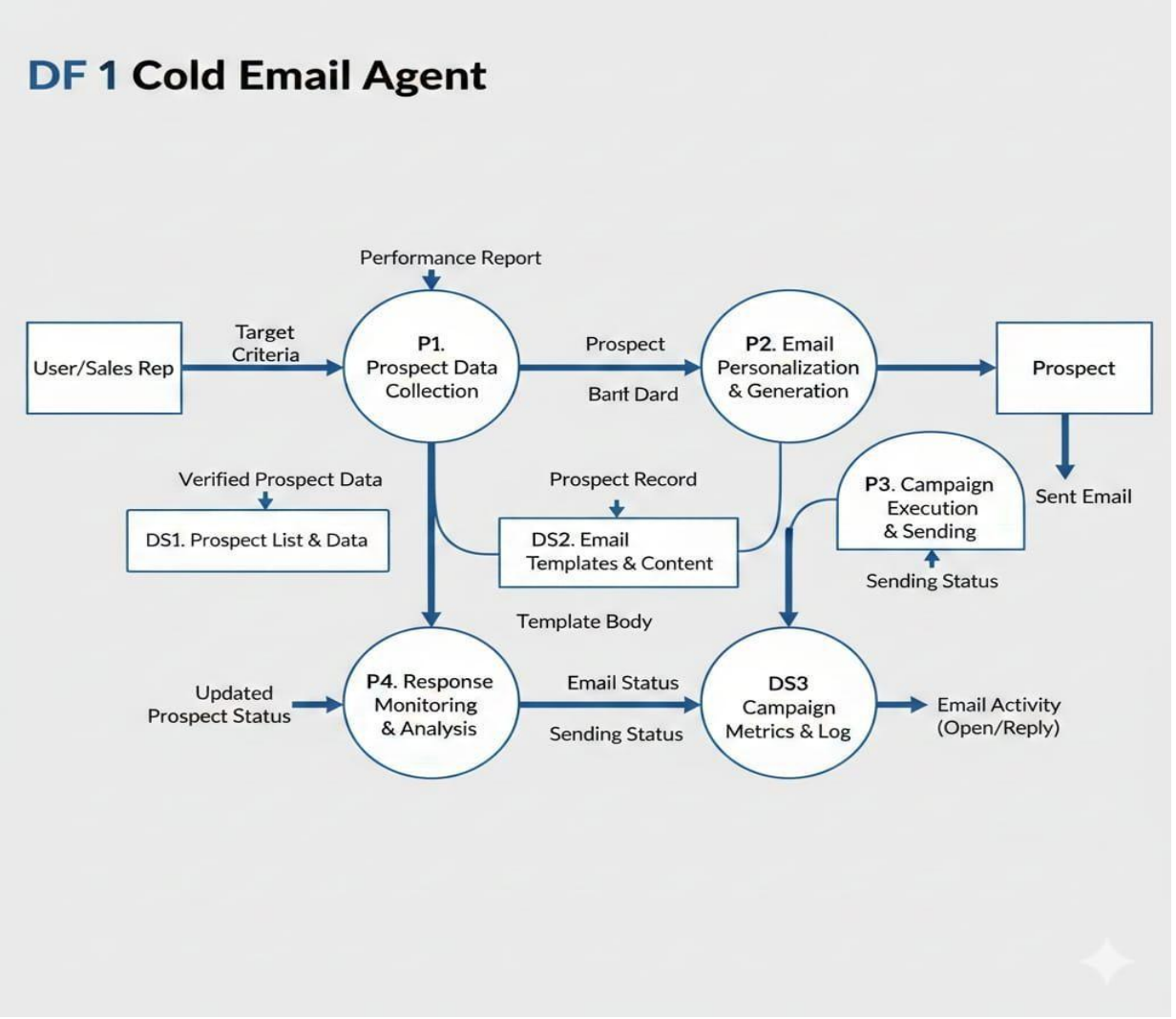

Fig 3.1.1 Data flow diagram

3.1.2 Level -1 DFD

The Level-1 Data Flow Diagram (DFD) of a Cold Email Agent system breaks the overall workflow into five main sub-processes that together automate the complete cold-email outreach cycle. First, the process begins with **Lead Data Import**, where lead information such as names, email addresses, and company details is fetched from external sources like Google Sheets, CRM platforms, or CSV files and stored in the Lead Database. Next, the **Template Generation** module uses an AI engine to create email templates based on user instructions, campaign goals, or marketing requirements. These templates are stored in the Template Repository. The **Email Personalization** process then customizes each email by merging the AI-generated template with individual lead data to produce unique, personalized messages intended to improve response rates. After personalization, the **Email Sending** module integrates with external email service providers such as Gmail API or SMTP servers to deliver the emails to recipients. Once the emails are sent, the **Tracking and Status Update** process records delivery results, timestamps, failures, and send statuses into a dedicated Logs Database. This Level-1 DFD provides a clear representation of the internal functioning of the Cold Email Agent, showing how data flows between processes, data stores, and external entities, ensuring automation,

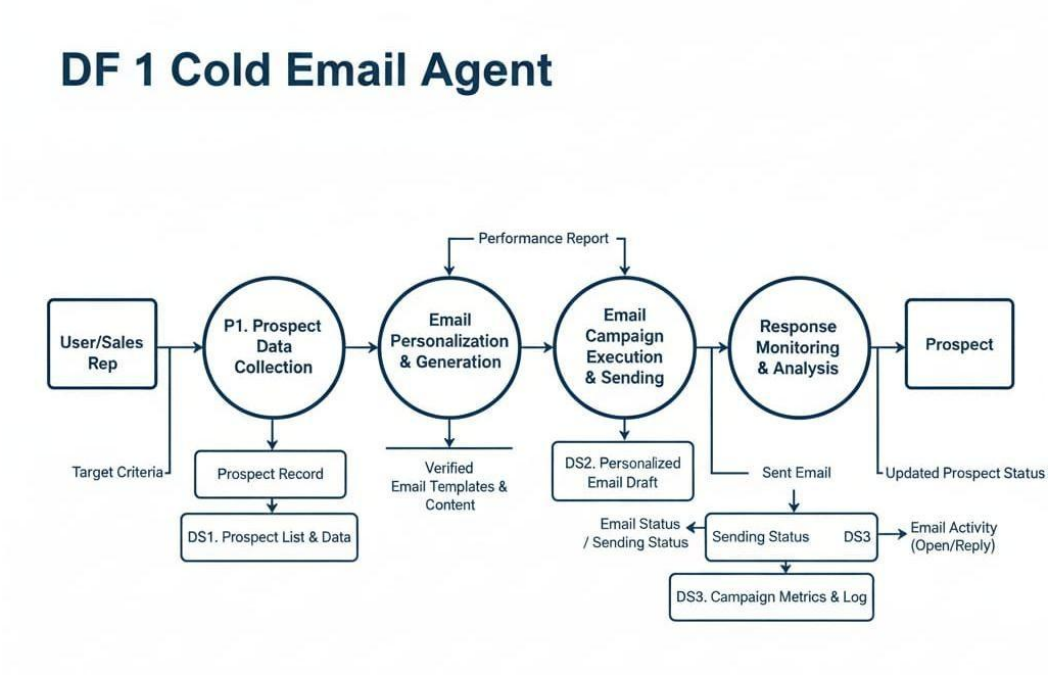

Fig 3.1.2: Level 1 DFD

3.1.3 Level-2 DFD

The Level-2 DFD of the Cold Email Agent breaks each main process into smaller operational steps to show how the system works in detail. The **Lead Data Import** process is divided into data fetching, data cleaning, and storing leads in the database. The **Template Generation** process includes collecting user inputs, creating AI prompts, and generating email templates. The **Email Personalization** process involves matching templates with leads, replacing variables like names and company details, and validating the final message. The **Email Sending** process is broken into authenticating Gmail/SMTP, dispatching emails, and handling delivery responses. Finally, the **Tracking and Status Update** process includes logging send results, tracking replies or bounces, and generating campaign performance reports. Overall, the Level-2 DFD shows a clear, detailed workflow of how data moves through the Cold Email Agent system.

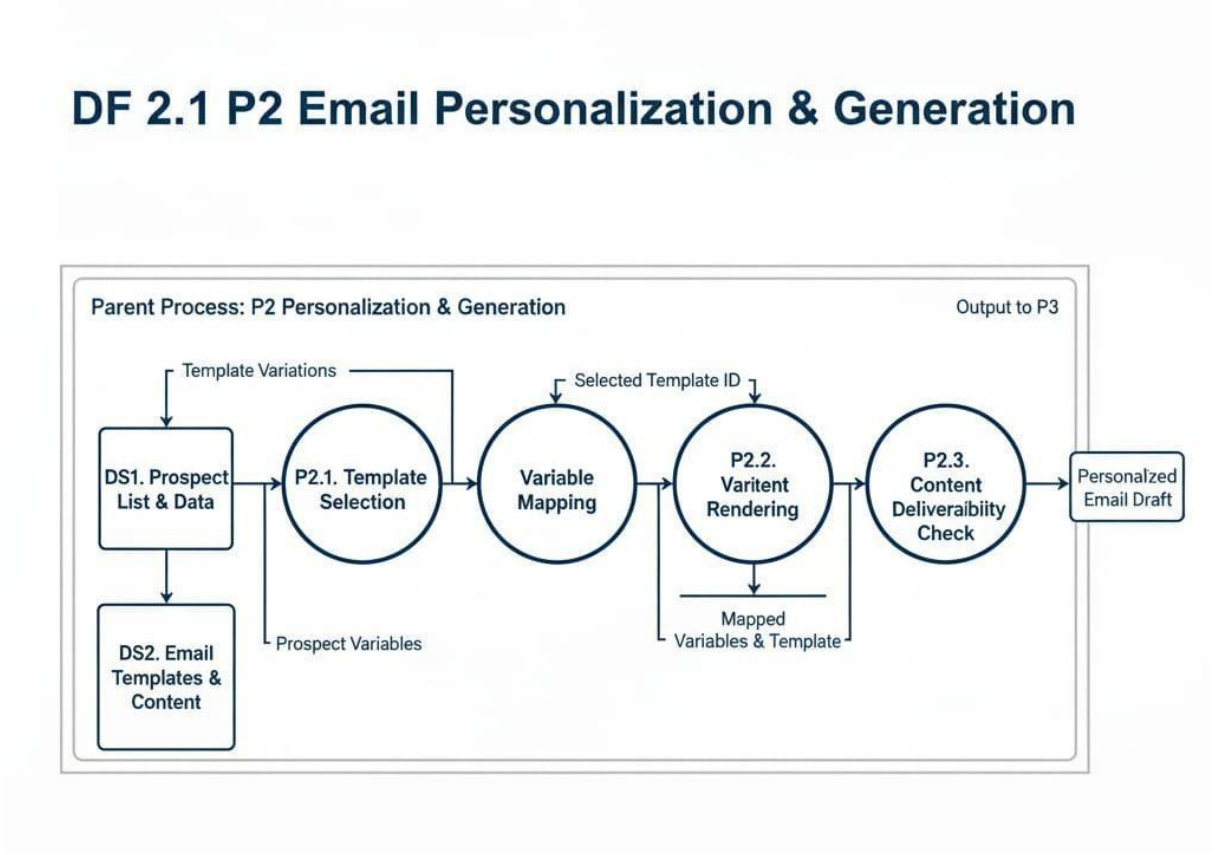

Fig 3.1.3 Level 2 DFD

CHAPTER 4

IMPLEMENTATION & MAINTENANCE

4.1 IMPLEMENTATION

The implementation of the Cold Email Agent involves developing all modules defined in the system design and connecting them into one automated workflow. Lead data is fetched from Google Sheets or CRM, cleaned, and stored. An AI module generates email templates, and a personalization module fills each template with lead details. The system then sends emails using Gmail API or SMTP and records delivery status, failures, and responses in a tracking database or sheet. Overall, the implementation ensures that the entire cold email process runs automatically with minimal manual effort.

4.2 IMPLEMENTATION PROCESS

a) System Development and Coding

The Cold Email Agent System was developed using technologies such as **Python (Flask/Fast API)** or **JavaScript (Node.js + n8n)** to automate email generation, personalization, and sending. The architecture was modular and consisted of the following components:

- **Email Generation Module**

  Uses AI/NLP models to generate personalized cold email content. Handles tone, length, and structure of emails.

- **Contact Management Module**

  Stores and manages lead information.

  Handles importing/exporting contacts and validating email IDs.

- **SMTP/Email Sending Module**

  Integrates with Gmail API, SMTP, or custom mail servers. Sends emails in bulk or individually.

  Manages retries, failures, and delivery status.

- **Template Management Module**

  Manages email templates for different campaigns.

b) System Integration

After all modules were developed, they were integrated to work together smoothly.For example: When a user uploads a contact list, the system sends it to the **Contact Module**, which validates it and passes it to the **Email Generator**.

When a campaign is started, the **Template Module** supplies content and the **SMTP Module** sends the email.

c) Testing and Quality Assurance

Multiple levels of testing were carried out to ensure the Cold Email Agent is reliable:

1. Unit Testing

- Tested individual functions like email generation, SMTP connection, link tracking, name- personalization, etc.

2. Integration Testing

- Verified data flow between modules
  (Contact list → Template → Sending → Status Tracking).

3. System Testing

- Tested the entire cold email workflow under real conditions.
- Checked limits, API errors, and large-scale sending.

4. User Acceptance Testing (UAT)

Ensured the system met user expectations in:

- Ease of creating campaigns
- Accuracy of email personalization
- Sending speed
- Response analytics and tracking

d) User Training

After the system became stable, training sessions were conducted. Users were trained on:

i. How to upload leads and manage contact lists.
ii. Selecting or creating email templates.
iii. Running campaigns and tracking statuses.
iv. Interpreting analytics (open rate, click rate, bounce rate).
v. Managing API keys and SMTP configurations.

e) System Deployment

a. Deployment involved installing and running the Cold Email Agent System in the target environment.

• Standalone Deployment

- Installed locally on a user's computer.
- Uses local configurations and SMTP clients.

• Cloud/Web Deployment

- Hosted on a cloud server (AWS, Render, Railway, etc.).
- Accessible through browser or API.
- Supports continuous uptime and automation.

• n8n + API Deployment (Automation-Based)

- Fully automated email sending pipelines.
- Integrated with Google Sheets, CRM, or databases.

f) Post-Implementation Review

After deployment, a review was performed to evaluate overall performance:

Review focused on:

Identifying issues such as email deliverability, bounce rates, or delays.

Understanding user experience with the dashboard and workflows.

Collecting feedback for improvements:

a. Better templates.

b. More personalization.

c. Improved analytics dashboard.

d. Enhanced tone analysis and scoring.

e. Smarter follow-up recommendations.

f. Faster email generation time.

4.3 ACTIVITY DIAGRAM

The process begins with the block labeled **"User Launches Cold Email Agent."** This represents the user opening the application or workflow, initiating the cold-email automation process. The system loads required modules such as email templates, contact lists, and AI generation components.

Email Creation Process:

Next, the flow moves to **"User Enters Recipient Details / Uploads Sheet."** Here, the user provides input such as recipient name, email address, purpose, and context. The AI module uses this information to generate a personalized email. The system then proceeds to **"AI Generates Cold Email Template."** In this stage, the agent analyzes user instructions, applies NLP, and creates a professional and customized cold email draft. The generated email is displayed to the user for review.

Possible Outcomes:

• "Yes – Send Email":

The user approves the generated email and chooses to send it. The system automatically connects to Gmail/SMTP API, delivers the email to the recipient, and logs the status (Sent, Delivered, or Failed). A confirmation message is displayed after successful delivery.

• "No – Regenerate / Edit Email":

The user decides not to send the email and opts to modify or regenerate the draft. The system returns to the email editing interface, allowing the user to revise the tone, structure, or content. The AI can regenerate a new version based on updated instructions.

Post-Sending Phase

- System updates Google Sheet / Database
- AI analyzes email tone & provides score (optional feature)
- System generates:
    - Update Google Sheet / Database
    - AI Tone & Quality Analysis
    - Delivery Confirmation
    - Summary Report Generation
    - Activity Logging
    - Automated Follow-Up (Optional)
    - Dashboard Update
    - End of Workflow

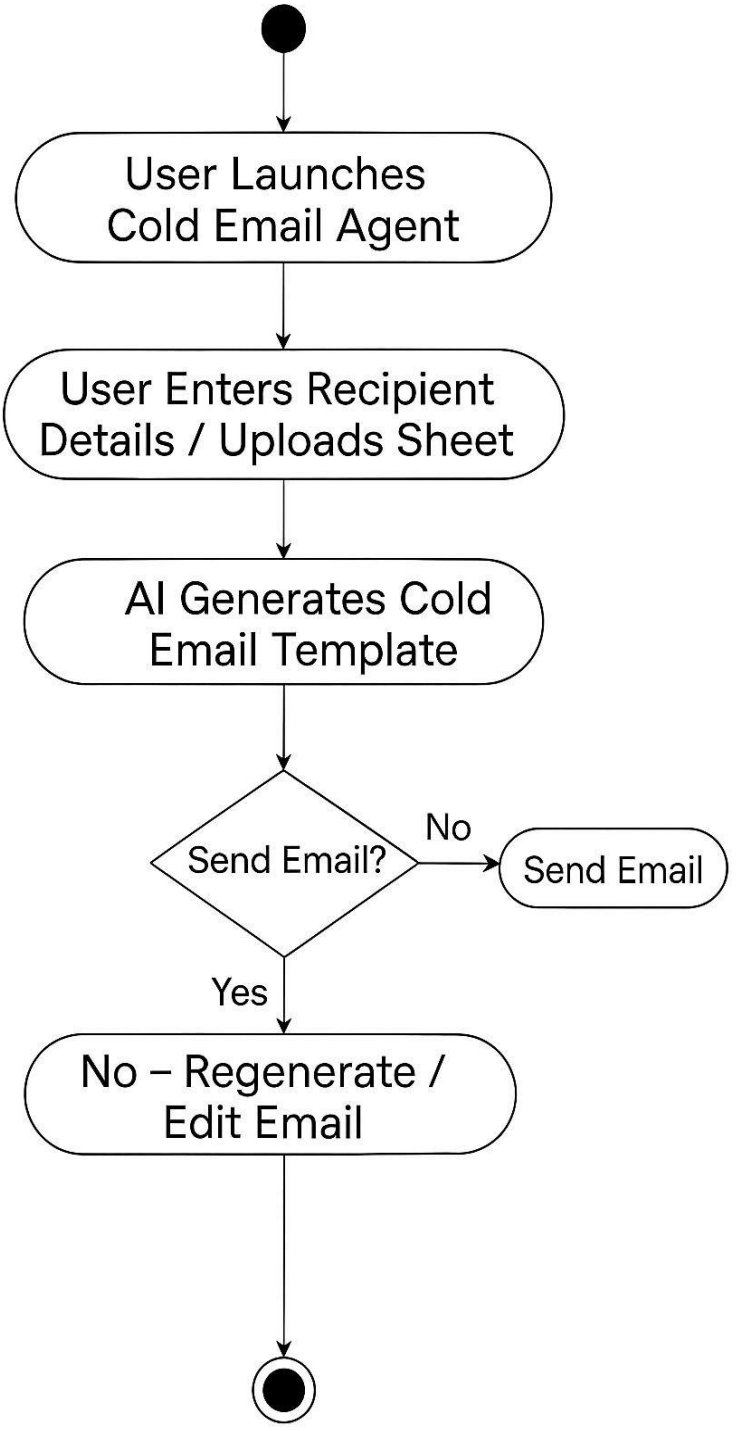

Fig 4.3: Activity Diagram

CHAPTER 5

SOFTWARE TESTING

5.1 SYSTEM TESTING

The purpose of software testing is to identify errors, enhance reliability, and ensure that the system performs exactly as expected under all operating conditions. In the context of the **AI-Powered Cold Email Agent**, testing helps verify that the system generates accurate email content, processes data correctly, integrates smoothly with external APIs, and sends emails without failure.

Testing ensures that each component of the system—from AI-based email generation to SMTP/Gmail integration—functions consistently and meets all design and user requirements. Since the system automates professional email communication, reliability, correctness, and consistency are critical. Errors such as incorrect personalization, failed email delivery, template formatting issues, or API miscommunication must be prevented.

System testing validates the overall workflow: receiving input, generating AI content, presenting an editable email draft, sending emails automatically, logging delivery details, and handling multiple recipients. By performing structured testing, the cold email agent is proven to be robust, scalable, and dependable in real-world usage scenarios.

5.1 TYPES OF TESTS

Unit Testing

Unit testing focuses on validating the smallest functional modules of the **Cold Email Agent**, ensuring that each unit works independently before integration. Each feature is tested individually to confirm that the internal logic behaves as intended.

Modules tested during unit testing include:

- **AI Email Generation Module** Ensures the AI model generates context-appropriate, grammatically correct, and properly structured cold emails.
- **Input Validation Module** Verifies recipient data such as email addresses, names, and custom fields.
- **Template Rendering Module** Confirms that placeholders (e.g., {{name}}, {{company}}, {{role}}) are replaced correctly.
- **Email Sending Module (SMTP/Gmail API)** Ensures successful authentication, connection, and email delivery without errors.

Functional testing ensures that every feature of the Cold Email Agent performs according to the defined user requirements and expected workflows.

Key functionalities tested include:

- Uploading or entering recipient details
- Auto-generating personalized cold email templates
- Editing the email subject and body
- AI regeneration of improved drafts
- Sending single or bulk emails
- Logging email delivery status
- Storing activity reports
- Real-time feedback on sending progress

System Testing

System testing evaluates the behavior of the **fully integrated Cold Email Agent** to verify that it meets all functional, technical, and performance requirements as one unified application.

Parameters tested include:

- End-to-end workflow from input → AI generation → sending → logging
- Email delivery accuracy and reliability
- Smooth integration of AI, backend logic, and Gmail/SMTP APIs
- Handling multiple recipients in batch mode
- Stability during high workload conditions
- Correct database updates and report generation

Performance Testing

Performance testing examines the speed, accuracy, and efficiency of the Cold Email Agent, especially during heavy usage or bulk email operations.

Important performance metrics include:

- **Email Generation Speed** AI must generate personalized drafts instantly or within milliseconds.
- **Bulk Email Sending Time** The system must send multiple emails quickly while respecting API rate limits.
- **System Responsiveness** UI should remain responsive during operations.

- **Integration Testing**

  Integration testing ensures that all modules in the AI-Powered Cold Email Agent work together without conflicts or data mismatches. Since the system relies heavily on external APIs and AI models, integration testing is crucial.
  Modules tested together include:

  - AI generation + Template processor
  - Template processor + Email sender
  - Email sender + Google Sheets/Database

5.2 ACCEPTANCE TESTING

User Acceptance Testing (UAT) is a crucial phase in validating the **AI-Powered Cold Email Agent**, ensuring that the system meets real-world user requirements and performs reliably in actual usage conditions. UAT involves evaluating the system from the perspective of end users, such as students, marketing teams, placement cells, startups, or professionals who depend on automated cold email communication.

S.No.	Test Scenario	Expected Result	Actual Result	Status
1	Launch Cold Email Agent	App opens smoothly	Opened in 2 sec	Pass
2	Upload recipient file	File validated & shown	Data loaded correctly	Pass
3	Generate AI email	Professional email created	Personalized email generated	Pass
4	Edit/Regenerate email	Editing & regen allowed	Worked without errors	Pass
5	Validate email formats	Invalid emails flagged	Incorrect emails detected	Pass
6	Send email via SMTP	Email delivered	Sent & confirmed	Pass
7	Bulk email sending	All recipients processed	Multiple emails sent	Pass
8	Log email status	Log timestamp & status	Log updated correctly	Pass
9	System performance	No lag or crash	Stable under load	Pass
10	Restart app check	Data should remain	Logs/settings retained	Pass

Figure: 5.2 Acceptance Testing

CHAPTER 6

METHODOLOGY

The AI-Powered Cold Email Agent is an automated workflow built using n8n automation combined with AI text generation, Google Sheets, and Gmail API/SMTP integrations. The system fully automates generating and sending personalized cold emails by orchestrating multiple connected nodes inside n8n. The methodology describes the hardware/software requirements, tools used, architecture, functional flow, and detailed setup required to build the automation pipeline.

6.1 HARDWARE REQUIREMENTS

Since the project is cloud- and workflow-based, minimal hardware is required:

- Laptop/PC with Intel i5 / Ryzen 5 processor
- 8GB RAM or above
- Stable internet connection
- Hard disk: 2GB free space
- Browser (Chrome/Brave/Firefox) for accessing n8n dashboard
- Optional: Server/VPS for 24×7 workflow execution

6.2 SOFTWARE REQUIREMENTS

The Cold Email Agent uses the following major software components:

1. n8n Automation Tool
   - Main platform for workflow creation
   - Handles triggering, branching, sending emails, and AI integration
2. OpenAI API
   - Used for generating personalized cold email templates
   - Integrated via the OpenAI Node inside n8n
3. Gmail API or SMTP
   - Used to automatically send emails
   - Configured inside the Gmail Node / SMTP Node
4. Google Sheets API
   - Stores contact lists, Reads recipient name, email, company, and other fields

6.2.1 KEY OBJECTIVES OF THE SOFTWARE SETUP

- To automate cold email creation using AI text generation
- To automate sending single or bulk emails using n8n
- To deliver a complete workflow from input → AI generation → preview → send → log
- To ensure reliable execution even with large contact lists
- To allow non-technical users to run the workflow with minimal interaction

6.2.2 OPERATING SYSTEM REQUIREMENTS

Operating System	Description
Windows 10/11	Best for development; easy to run n8n locally
Linux (Ubuntu 20.04+)	Highly efficient and preferred for hosting n8n server
macOS	Compatible with Node.js and n8n

Figure: 6.2.2 Operating System Requirements

6.2.3 DEVELOPMENT ENVIRONMENT

Component	Description
Automation Platform	n8n (local or cloud deployment)
Programming Language	JavaScript (used internally in n8n Function Node)
AI Integration	OpenAI GPT (system generates email content)
Data Source	Google Sheets / Excel CSV
Email Service	Gmail API / SMTP Node
Version Control	GitHub (optional)

Figure: 6.2.3 Development Environment

6.2.4 REQUIRED n8n NODES AND MODULES

1. Trigger Node

   Used to start workflow manually, on schedule, or via webhook.

2. Google Sheets Node
   - Reads recipient database
   - Updates sent status
   - Logs time, subject, body, and delivery results.

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- Function Node

  Used for:

  - Formatting the email
  - Replacing placeholders
  - Preprocessing data from Google Sheets

3. Gmail Node or SMTP Node
   - Sends email
   - Handles authentication
   - Returns message ID and delivery status

4. IF Node / Switch Node

   Used for condition-based flows:

   - Skip blank emails
   - Check if contact already emailed
   - Choose tone (formal, friendly, promotional)

6.3 SOFTWARE ARCHITECTURE (n8n Workflow)

The system architecture follows a pipeline-based automation workflow:

1. Input Module
   - Import recipient list through Google Sheets or CSV
   - Validate email addresses
   - Remove blank or duplicate entries
2. AI Email Generation Module
   - OpenAI Node generates personalized emails
   - Multiple variations generated if needed
3. Template Formatting Module
   - Function Node formats email body
   - Converts plain text to professional HTML
   - Inserts dynamic placeholders
4. Email Sending Module
   - Gmail Node or SMTP sends the email

5. Logging Module

Updates Google Sheets with:

- Email status (Sent / Failed)
- Timestamp
- Message ID

6. Notification Module (optional)

- Sends confirmation via Telegram / WhatsApp / Email

6.4 SOFTWARE FUNCTIONAL REQUIREMENTS

Functionality	Description
AI Email Generation	Must generate professional, personalized emails for each contact
Contact Reading	Retrieve recipient data from Google Sheets
Email Validation	System should detect and skip invalid emails
Bulk Email Sending	Send to multiple recipients sequentially
Logging	Save status of each email to database/sheet
Regeneration	User can regenerate or modify AI-generated email
Authentication	Gmail OAuth or SMTP credentials must be secure
Dashboard	Show preview of final email before sending (optional)

Figure:6.4 Software Function Requirement

6.5 SOFTWARE NON-FUNCTIONAL REQUIREMENTS

Parameter	Description
Performance	Workflow must generate emails in <2 seconds and send without delay
Reliability	No data loss, stable API calls, correct handling of failures
Security	All authentication tokens must be encrypted
Scalability	Should support hundreds of emails in one batch
Usability	Workflow must be easy to run by non-technical users
Portability	n8n workflow can run across Windows, Linux, or cloud
Maintainability	Nodes are modular and easily replaceable

Figure: 6.5 Software Non-Functional Requirement

CHAPTER 7

RESULT

7.1 AI-POWERED COLD EMAIL AGENT INTERFACE

The AI-Powered Cold Email Agent provides a clean and intuitive interface built using n8n workflow automation, integrated with Google Sheets, OpenAI, and Gmail/SMTP nodes. This chapter highlights the key output screens and system results generated during execution.

7.1.1 HOME SCREEN / WORKFLOW DASHBOARD

This section displays the main n8n workflow interface of the Cold Email Agent when the system is launched. The dashboard shows:

- The trigger node
- Google Sheets node for reading contacts
- OpenAI node for generating email content
- Function node for formatting
- Gmail/SMTP node for sending emails
- Google Sheets log node

The interface provides a complete visual representation of the automation pipeline. Users can start the workflow with a single click, monitor execution, and view node-wise outputs.

The workflow is designed to be simple, modular, and easy to operate even for users with minimal technical knowledge.

Fig 7.1.1: Home Screen Interface of AI-Powered Cold Email Agent (n8n Workflow)

7.1.2 DATA INPUT AND CONTACT FETCHING

This result demonstrates the successful import of recipient details from Google Sheets or a CSV file. n8n reads data row-by-row and extracts:

- Name
- Email address
- Company
- Context/purpose
- Custom fields

The output panel of the Google Sheets node displays the fetched records in JSON format, confirming that the workflow correctly identifies and loads all recipients.

Validation is also performed to ensure:

- No duplicate emails
- No empty rows
- Correct email structure

This ensures clean and reliable input before AI email generation.

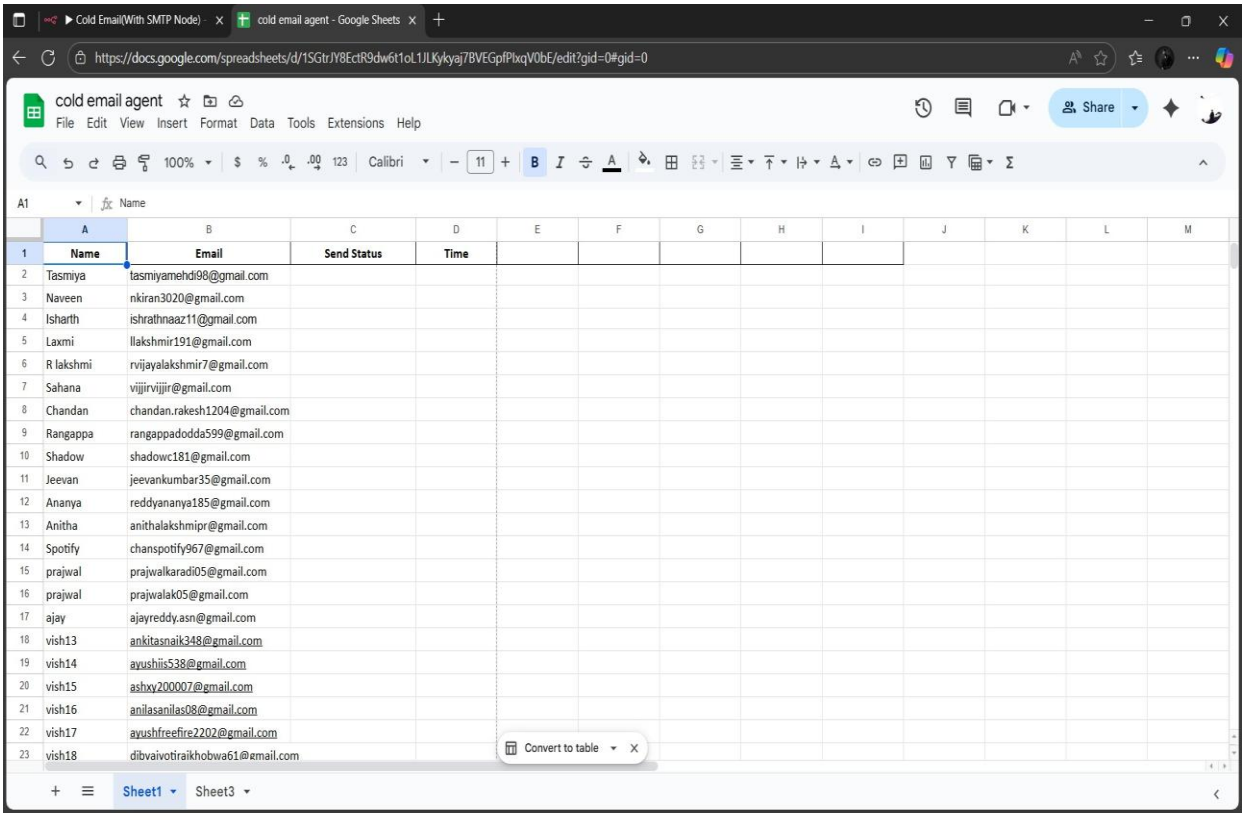


Fig 7.1.2: Contact Fetching and Data Extraction Output from Google Sheets Node

7.1.3 AI EMAIL GENERATION (OPENAI OUTPUT)

In this stage, the result shows the AI-generated cold email created by the OpenAI node inside n8n. OpenAI analyzes the input details such as:

- Recipient name
- Purpose of outreach
- Professional tone
- Project intent

The AI generates:

- A personalized subject line
- A context-specific email body
- Multiple variations if requested

The output window displays the generated email in structured form, confirming that the AI model responds accurately and professionally. The email content is grammatical, personalized, and suitable for immediate sending.

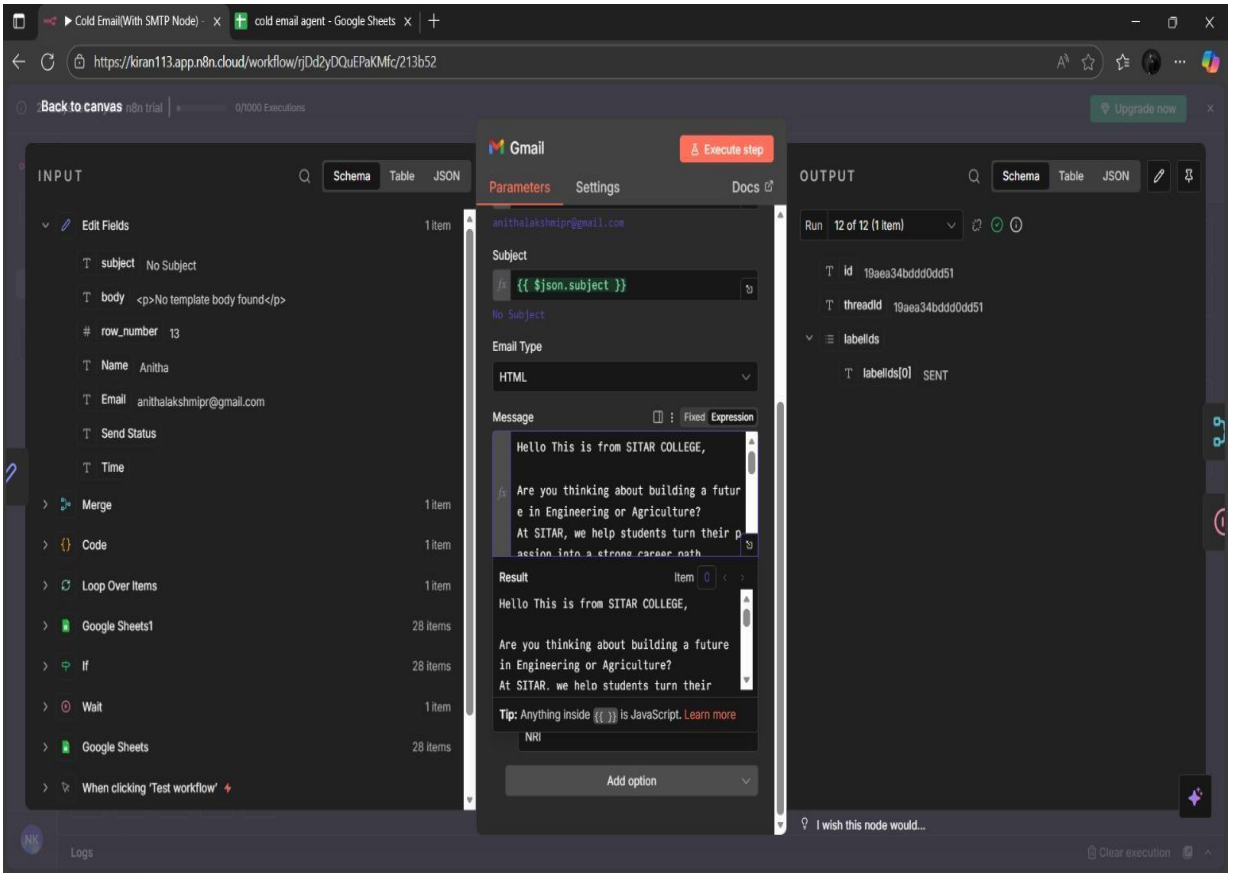


Fig 7.1.3: AI-Generated Cold Email Template Using OpenAI Node

7.1.4 EMAIL SENDING RESULTS (GMAIL/SMTP INTEGRATION)

This output demonstrates successful email delivery via the Gmail API or SMTP node in n8n.

When the email is sent:

- The Gmail node returns a Message ID
- The workflow logs the delivery status
- No errors in authentication or sending
- Bulk emails are processed sequentially

The email sending output panel confirms messages such as:

- "Email sent successfully"
- "SMTP connection established"
- "Delivery status: SUCCESS"

Additionally, conditional nodes (IF/Switch) help handle invalid emails or failed cases.

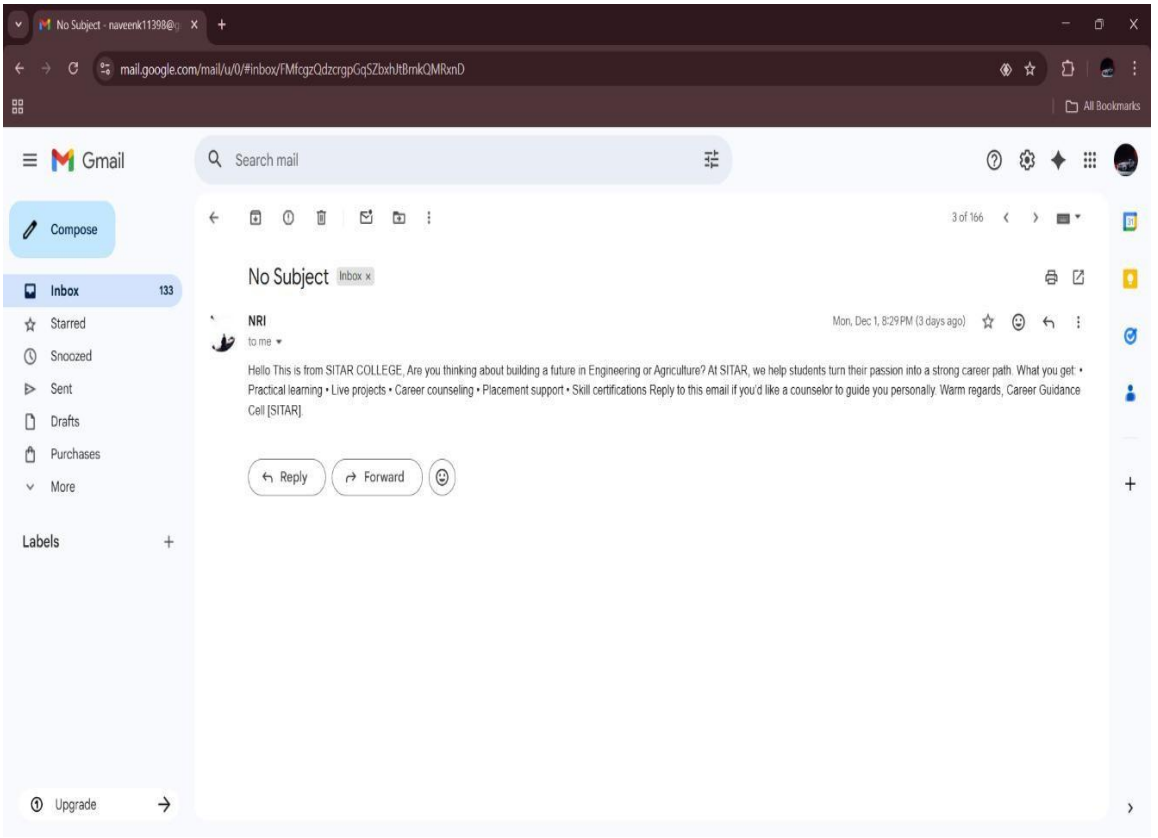


Fig 7.1.4: Gmail/SMTP Node Sending Cold Email Successfully

7.1.5 LOGGING OUTPUT AND WORKFLOW COMPLETION

The system provides options to log every sent email in a Google Sheet or database.

The log includes:

7.1.3.1 Recipient name, Email address, Generated subject

7.1.3.2 Timestamp of sending, Delivery status, Message ID

This ensures full transparency and traceability. The result also shows how the workflow updates each row after an email is sent. The log screen confirms that the Cold Email Agent delivers accurate reporting, making it useful for businesses, students, and marketing teams.

The completed workflow demonstrates:

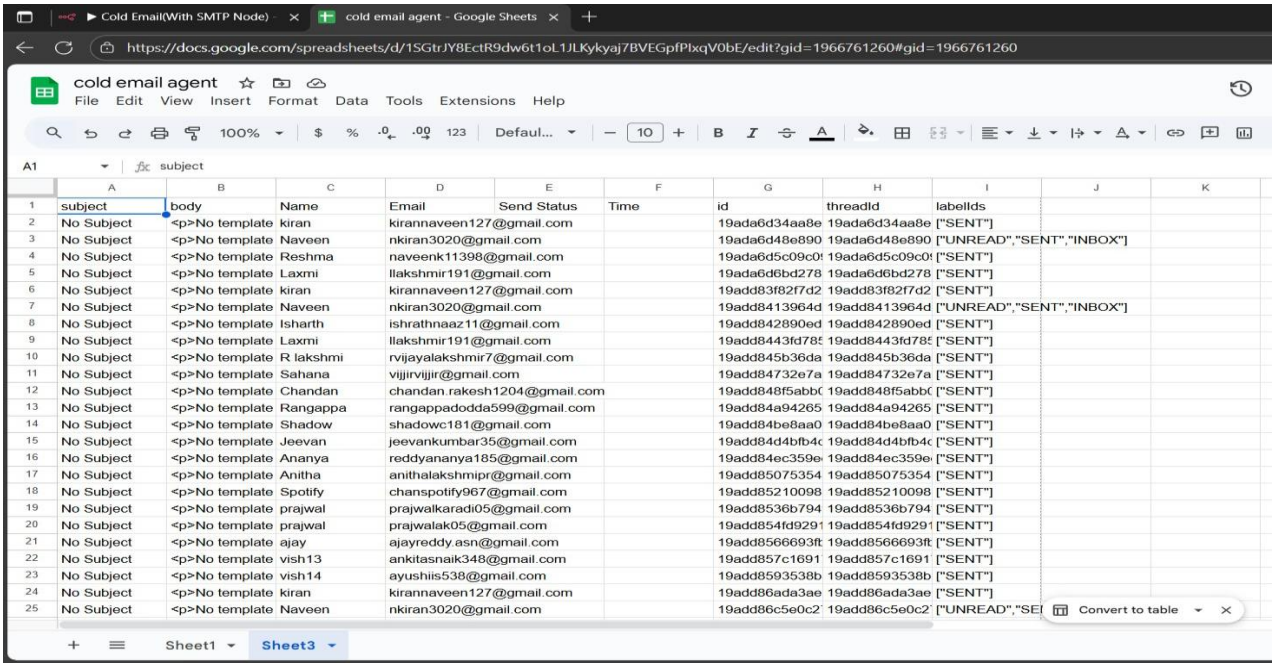
7.1.3.3 Successful AI email generation

7.1.3.4 Reliable integration of multiple n8n nodes

7.1.3.5 Accurate sending of emails to recipients

7.1.3.6 Real-time updates in Google Sheets

The system fulfills its objectives of creating an intelligent, automated email-sending environment that can be applied in lead generation, academic outreach, project communication, and marketing.



	A	B	C	D	E	F	G	H	I	J	K
1	subject	body	Name	Email	Send Status	Time	id	threadId	labelIds		
2	No Subject	<p>No template	kiran	kirannaveen127@gmail.com			19ada6d34aa8e	19ada6d34aa8e	["SENT"]		
3	No Subject	<p>No template	Naveen	nkiran3020@gmail.com			19ada6d48e890	19ada6d48e890	["UNREAD","SENT","INBOX"]		
4	No Subject	<p>No template	Reshma	naveenk11398@gmail.com			19ada6d5c09c0	19ada6d5c09c0	["SENT"]		
5	No Subject	<p>No template	Laxmi	llakshmir191@gmail.com			19ada6d6bd278	19ada6d6bd278	["SENT"]		
6	No Subject	<p>No template	kiran	kirannaveen127@gmail.com			19add83f82f7d2	19add83f82f7d2	["SENT"]		
7	No Subject	<p>No template	Naveen	nkiran3020@gmail.com			19add8413964d	19add8413964d	["UNREAD","SENT","INBOX"]		
8	No Subject	<p>No template	Isharth	ishrathnaaz11@gmail.com			19add842890ed	19add842890ed	["SENT"]		
9	No Subject	<p>No template	Laxmi	llakshmir191@gmail.com			19add8443fd785	19add8443fd785	["SENT"]		
10	No Subject	<p>No template	R lakshmi	rvijayalakshmir7@gmail.com			19add845b36da	19add845b36da	["SENT"]		
11	No Subject	<p>No template	Sahana	vijjirvijjir@gmail.com			19add84732e7a	19add84732e7a	["SENT"]		
12	No Subject	<p>No template	Chandan	chandan.rakesh1204@gmail.com			19add848f5abb(	19add848f5abb(	["SENT"]		
13	No Subject	<p>No template	Rangappa	rangappadodda599@gmail.com			19add84a94265	19add84a94265	["SENT"]		
14	No Subject	<p>No template	Shadow	shadowc181@gmail.com			19add84be8aa0	19add84be8aa0	["SENT"]		
15	No Subject	<p>No template	Jeevan	jeevankumbar35@gmail.com			19add84d4bfb4(	19add84d4bfb4(	["SENT"]		
16	No Subject	<p>No template	Ananya	reddyananya185@gmail.com			19add84ec359e	19add84ec359e	["SENT"]		
17	No Subject	<p>No template	Anitha	anithalakshmipr@gmail.com			19add85075354	19add85075354	["SENT"]		
18	No Subject	<p>No template	Spotify	chanspotify967@gmail.com			19add85210098	19add85210098	["SENT"]		
19	No Subject	<p>No template	prajwal	prajwalkaradi05@gmail.com			19add8536b794	19add8536b794	["SENT"]		
20	No Subject	<p>No template	prajwal	prajwalak05@gmail.com			19add854fd9291	19add854fd9291	["SENT"]		
21	No Subject	<p>No template	ajay	ajayreddy.asn@gmail.com			19add8566693ft	19add8566693ft	["SENT"]		
22	No Subject	<p>No template	vish13	ankitasnaik348@gmail.com			19add857c1691	19add857c1691	["SENT"]		
23	No Subject	<p>No template	vish14	ayushiis538@gmail.com			19add8593538b	19add8593538b	["SENT"]		
24	No Subject	<p>No template	kiran	kirannaveen127@gmail.com			19add86ada3ae	19add86ada3ae	["SENT"]		
25	No Subject	<p>No template	Naveen	nkiran3020@gmail.com			19add86c5e0c2	19add86c5e0c2	["UNREAD","SE		

Fig 7.1.5: Email Logs and Workflow Execution Completion

CONCLUSION

The development of the **AI-Powered Cold Email Agent** demonstrates how artificial intelligence and workflow automation can significantly enhance and modernize the way professional communication is carried out. By integrating **OpenAI's NLP capabilities** with the automation power of **n8n**, the system eliminates the need for manually drafting, personalizing, and sending cold emails tasks that traditionally require extensive time and effort.

The Cold Email Agent intelligently generates personalized, context-rich email content based on user- defined inputs such as recipient name, company, and purpose. With real-time AI-driven email creation, users receive professional and engaging email drafts that maintain linguistic accuracy, tone consistency, and relevance. The system's use of Gmail/SMTP and Google Sheets integrations ensures smooth and automated outreach, enabling bulk email sending with proper logging, validation, and delivery reporting.

Through n8n's visual workflow orchestration, every stage from data fetching to AI generation, formatting, sending, and logging becomes transparent and easy to manage, even for non-technical users. The automation pipeline ensures reliable execution, making email campaigns more efficient, scalable, and error-free. This enhances productivity for students, professionals, businesses, educational institutions, and marketing teams by reducing repetitive tasks and improving outreach quality.

While the system already performs efficiently, several areas offer opportunities for further improvement. Features such as automatic follow-up emails, sentiment analysis, recipient engagement tracking (opens/clicks), advanced personalization models, CRM integration, and dynamic template selection could enhance the system's intelligence and usability. Additional security enhancements and UI dashboards could further polish the overall experience.

Despite these potential upgrades, the AI-Powered Cold Email Agent successfully demonstrates the transformative potential of combining AI text generation with workflow automation. By bridging human intent with automated execution, it provides a powerful, modern communication tool that is fast, accurate, and highly adaptable. This project lays a strong foundation for future advancements in automated email outreach, intelligent communication systems, and AI-driven productivity tools.

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