**Agentic LLM for Receipt Management**

**A PROJECT REPORT SUBMITTED TO**

**SRM INSTITUTE OF SCIENCE & TECHNOLOGY**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE**

**AWARD OF THE DEGREE OF**

**MASTER OF COMPUTER APPLICATIONS**

**IN**

**GENERATIVE ARTIFICIAL INTELLIGENCE**

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**BONAFIDE CERTIFICATE**

This is to certify that the project report titled “**Agentic LLM for Receipt Management**” is a bonafide work carried out by **Abhijith S (REG NO. RA2432242010116), Ashvin Joseph (REG NO. RA2432242010116), Abhishek Gogoi (REG NO. RA2432242010116), Anandhu S (REG NO. RA2432242010115)** under my supervision for the award of the Degree of Master of Computer Applications in Generative Artificial Intelligence. To my knowledge the work reported herein is the original work done by these students.

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**ABSTRACT**

This project demonstrates an automated pipeline for extracting structured data from receipt images using **Google’s Generative AI (Gemini 2.5 Flash Lite)** model integrated with **Pydantic** and **LangChain’s output parser**. The goal is to accurately identify and structure key information such as the type of purchase, date, establishment name, itemized list of products, and total amount — all from a user-uploaded image of a receipt.

The system workflow begins with the **upload of a receipt image**, which is processed through Google’s **Generative AI client (genai)**. The uploaded image is paired with a carefully designed **prompt** that instructs the model to behave as a “receipt text extractor assistant.” This prompt enforces strict output formatting requirements, ensuring that the model returns **raw JSON data** conforming to a pre-defined schema. The schema is implemented using **Pydantic models**, specifically Item and receipts, which enforce type safety and validation for extracted fields such as name, price, quantity, and total.

A **PydanticOutputParser** from the **LangChain Core** library is utilized to transform the unstructured model output into a structured Python object. This enables efficient downstream processing and error handling while guaranteeing that the extracted data adheres to the specified format. The model response is then parsed, validated, and serialized into a JSON file (receipts2.json), allowing for storage and potential integration with accounting systems, expense trackers, or business analytics platforms.

By leveraging **Google Gemini’s multimodal capabilities**, the system demonstrates high accuracy and adaptability across diverse receipt layouts, fonts, and languages. The solution highlights the synergy between modern **generative AI**, **structured data validation (Pydantic)**, and **prompt engineering**, achieving an efficient, end-to-end receipt understanding workflow. This approach can be extended to other document understanding tasks such as **invoice processing, ID recognition, or form digitization**, making it a scalable and generalizable framework for intelligent document automation.

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1. **INTRODUCTION**

In the modern digital landscape, automation has become a cornerstone for enhancing efficiency and accuracy in business processes. One area that benefits greatly from automation is data extraction from financial documents such as receipts. Receipts play a crucial role in accounting, auditing, and personal finance management, as they provide detailed records of purchases, including establishment names, item lists, prices, dates, and total amounts. However, manual data entry from receipts is often time-consuming and susceptible to human error, creating a need for intelligent systems capable of performing this task automatically and reliably.

This project presents an AI-driven solution for automated receipt text extraction using **Google’s Generative AI (Gemini 2.5 Flash Lite)** model integrated with **Pydantic** and **LangChain’s PydanticOutputParser**. The system is designed to process receipt images, interpret the text and structure, and output validated data in a standardized JSON format. Unlike conventional Optical Character Recognition (OCR) methods that merely detect text, this approach leverages multimodal generative AI to understand both textual and contextual elements within the receipt, ensuring accurate extraction even from complex layouts and varied fonts.

The workflow begins with the uploading of a receipt image through the Google genai client. A carefully engineered prompt instructs the AI model to function as a “receipt text extractor assistant” and to produce results that conform to a predefined schema. This schema is implemented using Pydantic models, ensuring data integrity through strict validation of fields such as type of purchase, date, establishment name, itemized details, and total amount. The LangChain output parser converts the raw AI-generated text into a structured Python object, maintaining compliance with the expected data format. The final result is serialized into a JSON file, allowing for seamless integration with accounting systems, expense trackers, or data analytics platforms.

The system demonstrates how the fusion of **prompt engineering**, **Generative AI**, and **structured data validation** can significantly improve document processing workflows. It reduces human effort, minimizes transcription errors, and offers a scalable solution adaptable to various document types, including invoices, bills, and purchase orders. This project highlights the practical utility of multimodal AI in document understanding and paves the way for future advancements in intelligent automation for financial and administrative operations.

**2. SOFTWARE REQUIREMENT ANALYSIS**

The software requirement analysis defines the essential hardware and software components needed for the efficient execution of the receipt text extraction system. This analysis ensures that the environment used for development and deployment provides optimal performance, scalability, and compatibility with AI-based data processing tasks. The system integrates artificial intelligence through Google’s Generative AI model, structured data handling using Python’s Pydantic library, and data parsing through LangChain. The requirements have been determined based on factors such as model execution speed, image processing capability, and storage management for extracted results.

**2.1 Hardware Specification**

To implement and test the proposed system effectively, the following hardware specifications are recommended:

* Processor: Intel Core i5 or higher (Quad-Core or better)
* RAM: Minimum 8 GB (16 GB recommended for faster AI model execution)
* Storage: At least 256 GB SSD for efficient data handling and file management
* Graphics: Integrated GPU is sufficient; optional discrete GPU (NVIDIA GTX 1050 or higher) for accelerated image processing
* Display: 1080p resolution or higher for visualization and debugging
* Peripheral Devices: Keyboard, mouse, and reliable internet connection for accessing cloud-based APIs

These specifications ensure smooth execution of Python scripts, stable integration with Google’s cloud-based GenAI services, and quick processing of high-resolution receipt images.

**2.2 Software Specification**

The software environment forms the foundation for integrating AI processing, data validation, and structured output generation. The system is developed using the following tools and frameworks:

* Operating System: Windows 10 / 11 (or Linux-based OS such as Ubuntu 22.04)
* Programming Language: Python 3.10 or above
* Libraries and Frameworks:
  + google-genai – for interaction with Google’s Gemini model
  + dotenv – for loading API keys securely from environment files
  + pydantic – for defining data models and validation schemas
  + langchain\_core – for structured output parsing and prompt management
  + json – for data serialization and storage
* Editor/IDE: Visual Studio Code or PyCharm for development and debugging
* Environment Manager: pip or conda for package management

This configuration ensures modularity, portability, and compatibility across different development platforms.

**2.3 About the Software and Its Features**

The developed system is an AI-based receipt text extraction application designed to automate the process of converting unstructured receipt images into structured digital data. It leverages Google’s Generative AI for intelligent interpretation of textual and visual data, enabling high accuracy in recognizing complex receipt formats. The system features include:

* Automated Data Extraction: Reads and interprets receipt images using the Gemini AI model.
* Structured Data Validation: Ensures consistency and accuracy through Pydantic model validation.
* Prompt-Driven AI Processing: Uses custom-designed prompts for precise and context-aware extraction.
* JSON Output Generation: Stores the final structured output in a standardized, machine-readable format.
* Scalability: Can be extended to process other financial documents like invoices and bills.

Overall, the software provides an efficient, accurate, and scalable approach to automating document understanding tasks using state-of-the-art AI technologies.

**3. SYSTEM ANALYSIS**

System analysis is a critical phase in software development, focusing on understanding the existing workflow, identifying limitations, and proposing improvements for more efficient and accurate processes. For this project, the objective is to analyze the current methods of receipt management and highlight the improvements offered by an AI-powered automated system.

**3.1 Existing System**

Traditionally, receipt management and data extraction are performed manually. Users record purchase details from printed or digital receipts into accounting books, spreadsheets, or enterprise software. This approach is labor-intensive, time-consuming, and highly prone to errors, especially when handling large volumes of receipts. Conventional Optical Character Recognition (OCR) tools provide partial automation by detecting printed text from images. However, OCR-based methods often fail with handwritten entries, complex receipt layouts, poor image quality, or varied fonts. Additionally, OCR systems require significant post-processing to structure extracted data, which limits their efficiency and reliability for financial reporting and analytics.

**3.2 Proposed System**

The proposed system leverages **Generative AI (Google Gemini 2.5 Flash Lite)** for intelligent receipt interpretation, combined with **Pydantic** and **LangChain’s structured output parser** to produce validated, structured data. Instead of merely detecting text, the system understands the contextual meaning and layout of receipts, enabling accurate extraction of fields such as **type of purchase**, **date**, **establishment name**, **item details**, and **total amount**. The workflow begins with image upload, followed by prompt-guided AI processing. The output is parsed into a Pydantic model to enforce data integrity and is saved as a JSON file for integration with accounting systems or analytics platforms. This approach eliminates manual data entry, reduces errors, and significantly improves processing speed.

**3.3 Feasibility Study**

The feasibility of the proposed system has been evaluated in terms of **technical, operational, and economic factors**. Technically, the system is feasible due to the availability of robust AI models, Python libraries for structured data validation, and cloud-based APIs for scalable computation. Operational feasibility is high because the system requires minimal user intervention, automates complex tasks, and integrates easily with existing digital workflows. Economically, the solution reduces labor costs associated with manual data entry and enhances productivity, making it cost-effective for small businesses and enterprises alike. Overall, the proposed AI-based receipt extraction system is practical, reliable, and offers measurable benefits compared to the existing manual or OCR-dependent methods.