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**LAVAZZA**  
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# AI PERSONAS

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**Xiaoning Ma - s337332**

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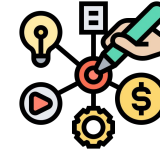
## Introduction

- Challenges
- Objective
- Research Questions



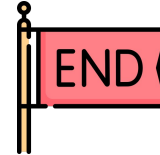
## Methodology

- Method
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## Conclusion

- Conclusion
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# Challenges

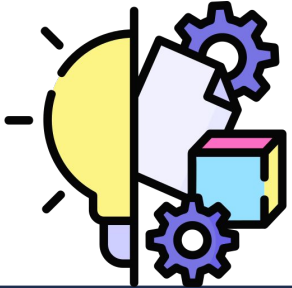
In the context of delivering new products or enhancing existing ones, main pains are:

- **Consumers Insight Department** -> high time demand for data collection and analysis
- **Product Department** -> product development and product testing difficulties
- **Marketing Department** -> high cost and uncertain advertisement campaigns
- **IT Department** -> limited data, model testing



# Objective - Project Value Proposition

For **business units** struggling in **evaluating marketing performances**, **customer understanding**, **models and ideas testing**, our software allows **interacting with data-driven AI Personas** representing the different **market segments**



# Objective - Sustainable Development Goals

Our project is aligned with the **SDG 9 - Industry, Innovation and Infrastructure**.  
By using advanced AI improve company's efficiency and effectiveness.



# Objective - Project Goal

The goal is to develop a **software application** where employees can **interact** dynamically with **AI Personas** representing different **market segments** to:

- Identify weak ideas at an earlier phase by saving time and resources
- Enable focused market strategies
- Scale winning concepts efficiently and effectively



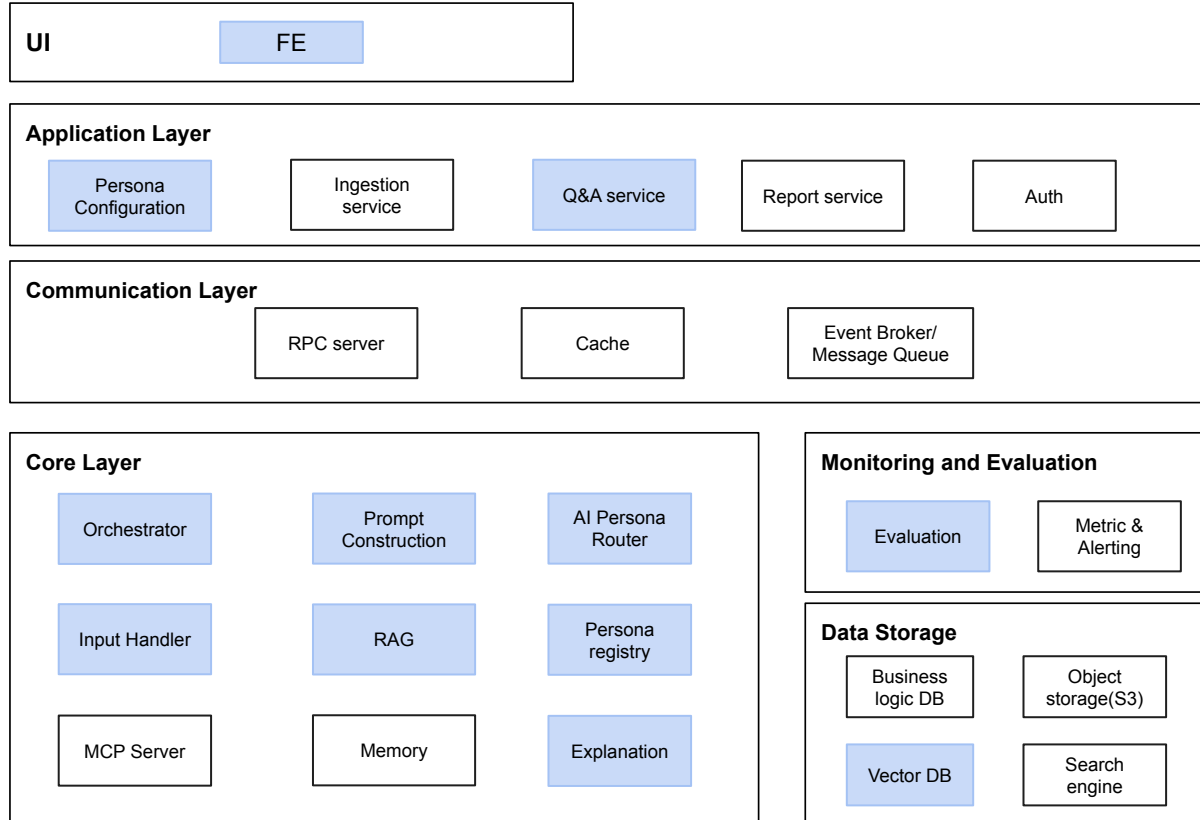
**Q1 (Extraction):** How can we extract structured data from complex, visually rich PDF in an accurate and automated way?

### Q3 (Grounding): How to prevent models from hallucinations?





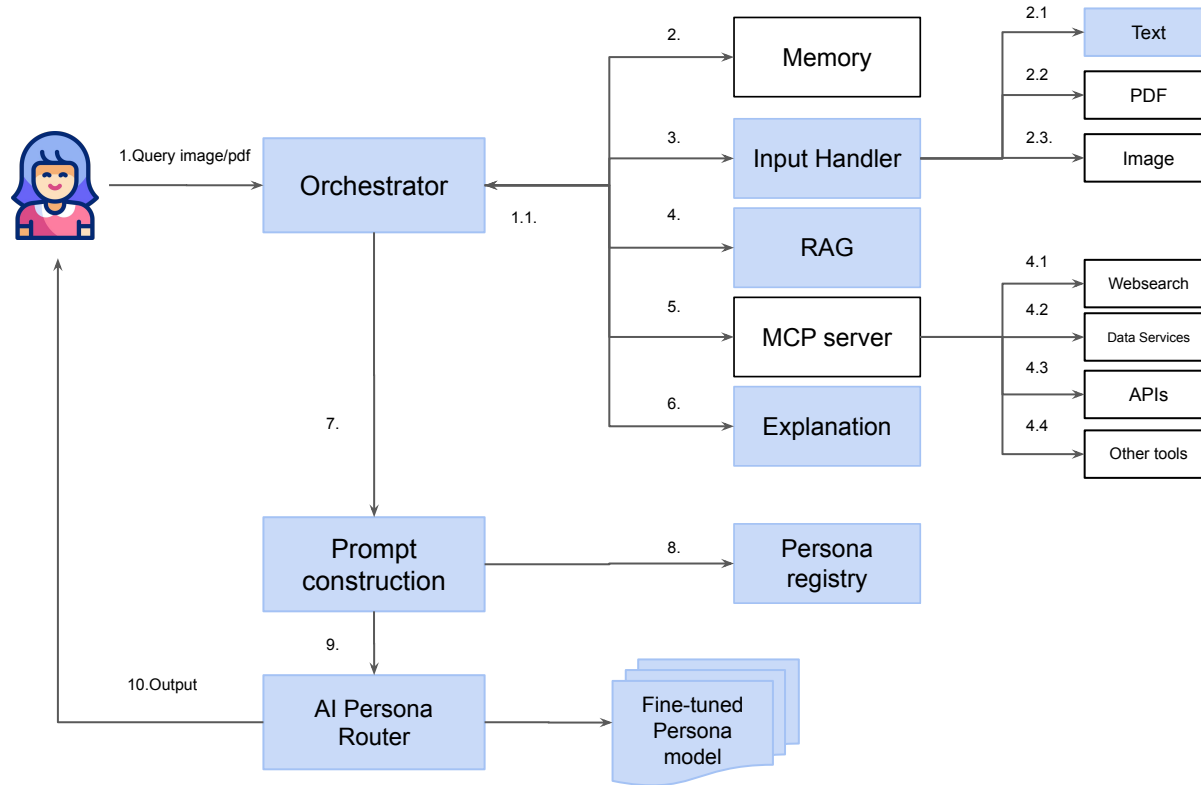
# Method - System Architecture



(\*) More details in the Appendix

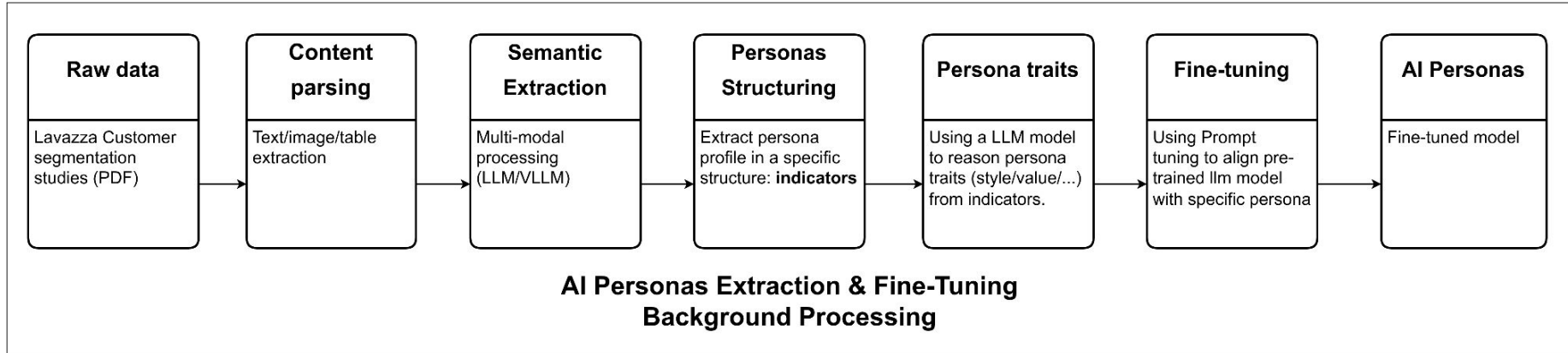


# Method - Functional Diagram

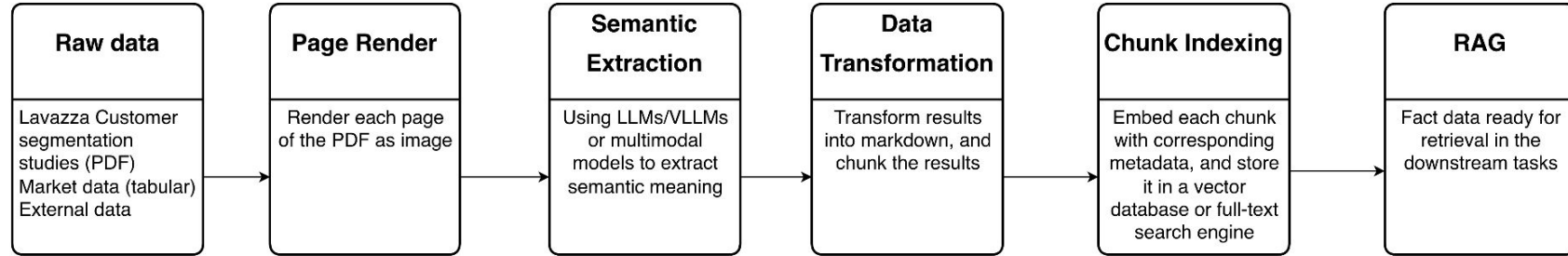


(\*) More details in the Appendix

# Method - Functional Diagram



# Method - Functional Diagram



**Fact Data pipeline  
Background Processing**

# Experiment - LLM Generation Demo



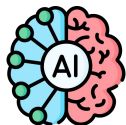
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## Front End

## Back End



In general, what is your age?



As Curious Connoisseurs, we tend to skew toward older groups, with a significant portion of our demographic falling between 35 and 70 years old. Specifically, 35% are between 35-44 years, 15% are between 45-54 years, and 24% are between 55-70 years. Our average age is 47 years, reflecting a mature and experienced cohort. This age distribution aligns with our exploratory nature and appreciation for high-quality, innovative products.

Load Persona JSON

Embed snippets

Index embeddings

Retrieve relevant  
snippets

Build system prompt

Generate persona-style  
answer

# Experiment - Data Description



## *Source & Scale*

- Kantar France 2023
- 4,001 Respondents
- 9 consumer segments
- Rich qualitative + quantitative data



## *Data Structure*

- Multi-modal composition
- Inconsistent layouts across segments
- Mixed granularity
- No unified or machine-readable format



## *Key Dimensions*

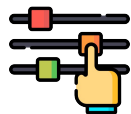
- Demographics
- Psychographics
- Coffee attitudes
- Consumption behaviours
- Brand perception & sustainability attitudes

# Experiment - Experiment Configuration



## *Model*

- ❑ MPNet: Converts persona indicators into vector embeddings
- ❑ Mistral: Produces the final persona-styled answer

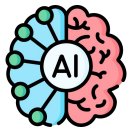


## *Parameters*

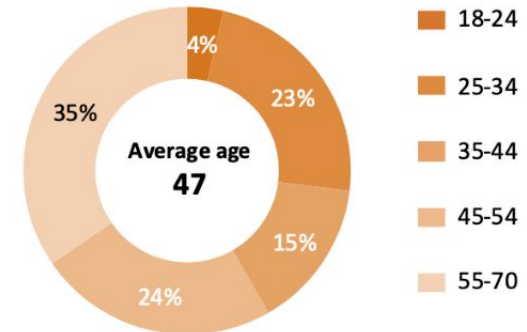
- ❑ Temperature = 0.5    Balanced creativity and consistency
- ❑ Top-p = 0.5    Limits randomness; promotes focused outputs
- ❑ Max tokens = 4024    Allows long persona-consistent explanations
- ❑ Timeout = 300s    Ensures long retrieval/generation runs complete

# Experiment - Quality Assessment

In general, what is your age?



As Curious Connoisseurs, we tend to skew toward older groups, with a significant portion of our demographic falling between 35 and 70 years old. Specifically, 35% are between 35-44 years, 15% are between 45-54 years, and 24% are between 55-70 years. Our average age is 47 years, reflecting a mature and experienced cohort. This age distribution aligns with our exploratory nature and appreciation for high-quality, innovative products.



# Conclusions



## ***Objective***

To create data-driven AI personas that support accurate consumer insight and decision-making.

## ***Method***

We combined multi-modal data extraction, persona trait generation, and a RAG-enhanced LLM pipeline within an orchestrated system architecture.

## ***Why Effective***

This approach ensures factual grounding, consistent persona behavior, and reliable, insight-aligned responses.



# Manage



**Enrico**

- Semantic extraction of fact data
- Fact data indexing
- Retrieval logic in RAG system
- Corresponding slides



**Thanh**

- System architecture design
- Persona semantic data extraction
- AI persona prompt tuning
- Corresponding slides



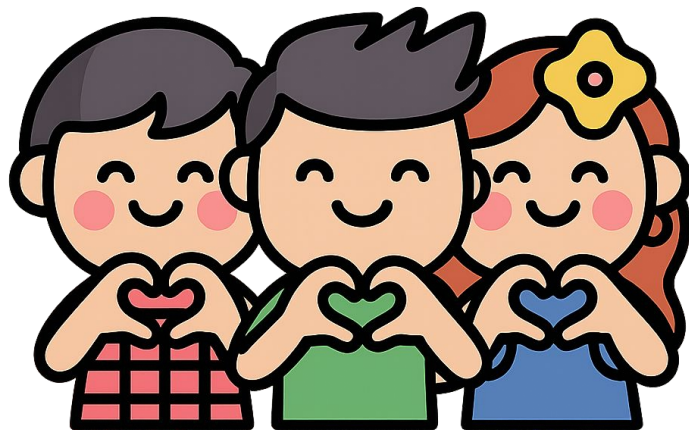
**Xiaoning**

- AI persona common trait extraction
- AI persona inference and serving
- Quality assessment
- Corresponding slides



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**THANK YOU**

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# **Appendix**

# Manage - Gantt

									PH				
WB No	TASK TITLE	DEPEN ON	OWNER	COLLABORATORS	START	END	PERSON WEEK	PROGRESS (%)	11/2025				
									w1	w2	w3	w4	
1	Project Conception and Initiation		Thanh	Others	03/11/2025	14/11/2025	3.00						
1.1	Project structure+ work flow		Thanh	Others	03/11/2025	03/11/2025	0.50	100.00					
1.2	Kick off with Lavazza tutor		XiaoNing	Others	03/11/2025	07/11/2025	0.50	100.00					
1.3	Research		Enrico	Others	03/11/2025	14/11/2025	2.00	100.00					
2	Design	1	Enrico	Others	03/11/2025	16/11/2025	7.50						
2.1	Objective and Goal Definition	1.2	Thanh	Others	03/11/2025	14/11/2025	0.50	100.00					
2.2	Stakeholder Map	1.2	Enrico	Others	03/11/2025	14/11/2025	1.00	100.00					
2.3	User Personas Definition	1.2	Enrico	Others	03/11/2025	14/11/2025	0.50	100.00					
2.4	User Journey Definition	1.2	XiaoNing	Others	03/11/2025	14/11/2025	1.00	100.00					
2.5	User Requirements Definition	1.2	XiaoNing	Others	03/11/2025	14/11/2025	0.50	100.00					
2.6	Usecase diagram	1.2;1.3	XiaoNing	Others	03/11/2025	16/11/2025	1.00	100.00					
2.7	Func and Non-Func Requirements Definition	1.2;1.3	Enrico	Others	03/11/2025	16/11/2025	1.00	100.00					
2.8	System Architecture and Func Diagram	1.2;1.3	Thanh	Others	03/11/2025	16/11/2025	1.00	100.00					
2.9	Risk Analysis	1.2;1.3	Thanh	Others	08/11/2025	16/11/2025	1.00	100.00					
3	Management	2	XiaoNing	Others	08/11/2025	16/11/2025	1.00						
3.1	Tasks Breakdown and Gantt Diagram	2	XiaoNing	Others	08/11/2025	16/11/2025	1.00	100.00					



# Manage - Gantt



WB No	TASK TITLE	DEPEN ON	OWNER	COLLABO RATORS	START	END	PERSON WEEK	PROGRESS (%)	PHASE ONE									
									11/2025					12/2025				
									w1	w2	w3	w4	w5	w6	w7	w8	w9	w10
4	Data Foundation	1.2	Thanh	Others	17/11/2025	23/11/2025	6.00											
4.1	Data acquisition & ingest	1.2	Thanh	Others	17/11/2025	23/11/2025	3.00	90.00										
4.1.1	Collect data from Lavazza	1.2	Enrico	Others	17/11/2025	21/11/2025	1.00	100.00										
4.1.2	Collect data from external source		Thanh	Others	17/11/2025	21/11/2025	1.00	100.00										
4.1.3	Understand dataset	4.1.1;4.1.2	XiaoNing	Others	21/11/2025	23/11/2025	1.00	100.00										
4.2	Finalize PersonaProfile schema	4.1	XiaoNing	Others	20/11/2025	28/11/2025	1.00	100.00										
4.3	Data processing pipelines	4.2	Thanh	Others	20/11/2025	30/11/2026	2.00	100.00										
4.3.1	Handle fact data pipeline	4.2	Enrico	Thanh	20/11/2025	30/11/2025	1.00	100.00										
4.3.2	Handle persona data pipeline	4.2	XiaoNing	Thanh	20/11/2025	30/11/2025	1.00	100.00										
5	Prompt Tuning AI Persona	4.3.2	XiaoNing	Thanh	24/11/2025	27/12/2025	4.00											
5.1	Semantic Extraction/Personas Structuring from Customer Segmentation Data	4.3.2	XiaoNing	Thanh	24/11/2025	12/12/2025	2.00	100.00										
5.1.1	Extract common traits/rules for each personas	4.3.2	XiaoNing	Thanh	24/11/2025	12/12/2025	1.00	100.00										
5.1.2	Create personas fine-tuning dataset	4.3.2	XiaoNing	Thanh	30/11/2025	12/12/2025	1.00	100.00										
5.2	Implement Training pipeline	5.1	Thanh	XiaoNing	01/12/2025	28/12/2025	1.50	30.00										
5.3	Implement Inference & serving	5.2	Thanh	XiaoNing	13/12/2025	28/12/2025	0.50	0.00										
6	Fact Data Ingestion	4.3.1	Enrico	Others	24/11/2025	21/12/2025	2.50											
6.1	Semantic Extraction from Fact Data	4.3.1	Enrico	Thanh	24/11/2025	21/12/2025	1.00	50.00										
6.2	Indexing fact data	6.1	Enrico	Thanh	24/11/2025	21/12/2025	0.50	30.00										
6.3	Implement retrieval logic with RAG	6.2	Enrico	Thanh	01/12/2025	21/12/2025	1.00	30.00										



# Manage - Gantt

WB No	TASK TITLE	DEPEN ON	OWNER	COLLABO RATORS	START	END	PERSON WEEK	PROGRESS (%)	PHASE ONE									
									11/2025			12/2025				01/2026		
									w1	w2	w3	w4	w5	w6	w7	w8	w9	w10
7	Core Layer	4;5;6	Thanh	Others	01/12/2025	28/12/2025	8.50											
7.1	Input handling	4	XiaoNing		01/12/2025	14/12/2025	1.00	20.00										
7.2	Retrieval-Augmented Generation	6	Enrico		07/12/2025	28/12/2025	1.50	20.00										
7.3	Implement Orchestrator logic	7.1;7.2	Thanh	Others	07/12/2025	28/12/2025	2.00	10.00										
7.4	Implement Explanation module	7.3	Thanh		07/12/2026	28/12/2025	1.00	0.00										
7.5	Prompt construction	7.3	Enrico	Others	07/12/2027	28/12/2025	1.00	10.00										
7.6	Persona registry	5	XiaoNing		07/12/2025	28/12/2025	1.00	20.00										
7.7	AI Persona Router	5	Thanh		07/12/2025	28/12/2025	1.00	0.00										
8	Application Layer	7	XiaoNing	Others	15/12/2025	04/01/2026	2.00											
8.1	Persona configuration	7.6	Thanh	Others	15/12/2025	04/01/2026	1.00	0.00										
8.2	Q&A service	7	Enrico	Others	15/12/2025	04/01/2026	1.00	0.00										
9	UI	8	XiaoNing	Others	22/12/2025	04/01/2026	1.50											
9.1	FE	8	XiaoNing	Others	22/12/2025	04/01/2026	1.50	0.00										





# Manage - Gantt

WB No	TASK TITLE	DEPEN ON	OWNER	COLLABO RATORS	START	END	PERSON WEEK	PROGRESS (%)	PHASE ONE									
									11/2025			12/2025				01/2026		
									w1	w2	w3	w4	w5	w6	w7	w8	w9	w10
10	Monitoring and Evaluation	7	Enrico	Others	22/12/2025	11/01/2026	2.00											
10.1	Evaluation	7	Enrico	Others	22/12/2025	11/01/2026	2.00	0.00										
11	Deployment	7;8;9	Thanh	Others	22/12/2025	11/01/2026	2.00											
11.1	Packaging	7;8;9	Thanh	Others	22/12/2025	11/01/2026	1.00	0.00										
11.2	Deploy entire system	11.1	Thanh	Others	22/12/2025	11/01/2026	1.00	0.00										
12	Testing	7;8;9	XiaoNing	Others	22/12/2025	11/01/2026	2.00											
12.1	Test	7;8;9	XiaoNing	Others	22/12/2025	11/01/2026	1.00	0.00										
12.2	Fix Bug	12.2	Thanh	Others	22/12/2025	11/01/2026	1.00	0.00										
13	Demo	12	Enrico	Others	29/12/2025	11/01/2026	1.00											
13.1	Run full flow & get feedback	12	Enrico	Others	22/12/2025	11/01/2026	1.00	0.00										



# Manage - Gantt

WB No	TASK TITLE	DEPEN ON	OWNER	COLLABO RATORS	START	END	PERSON WEEK	PROGRESS (%)	PHASE ONE									
									11/2025			12/2025				01/2026		
									w1	w2	w3	w4	w5	w6	w7	w8	w9	w10
14	Communication		Enrico	Others	14/11/2025	19/11/2025	5.00											
14.1	First Checkpoint Presentation		Enrico	Others	14/11/2025	19/11/2025	1.00	100.00										
14.2	Second Checkpoint Presentation		XiaoNing	Others	02/12/2025	09/12/2025	1.00	100.00										
14.3	Third Checkpoint Presentation		Thanh	Others	30/12/2025	06/01/2026	1.00	0.00										
14.4	Final Presentation		Enrico	Others	23/12/2025	12/01/2026	1.00	0.00										
14.5	Final Report		XiaoNing	Others	23/12/2025	13/01/2026	1.00	0.00										





# Design

## 1. User Interface (UI)

The user interface serves as the system's entry point, built as a **Frontend (FE)** application. It enables users to interact seamlessly with the platform, submit queries, upload data, and view results or reports.

## 2. Application Layer

This layer contains the core application logic and manages all user-driven workflows.

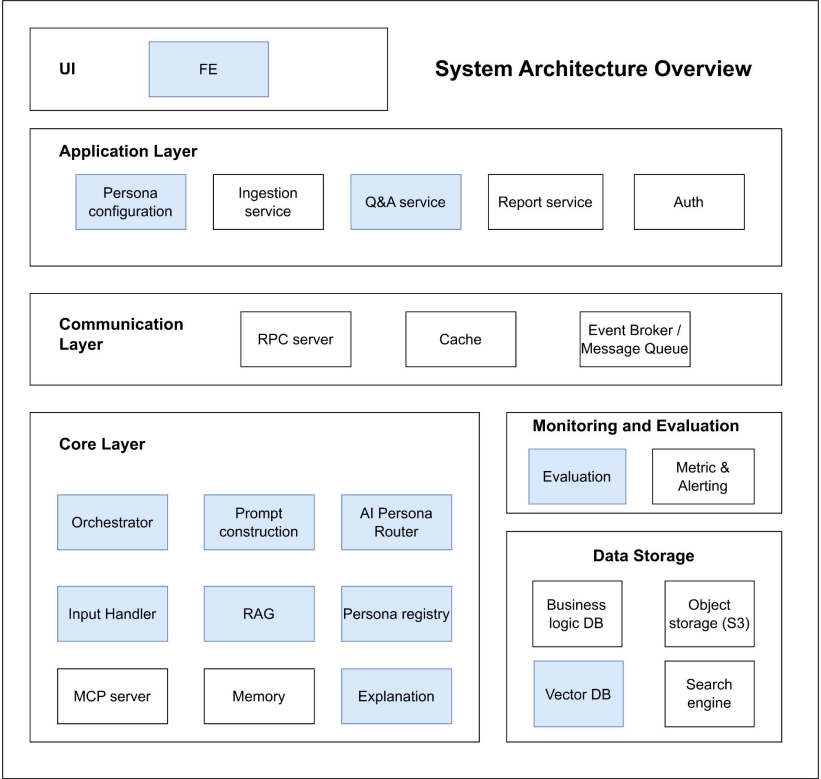
Key components include:

- **Persona Configuration:** Enables users to select or customize AI personas dynamically.
- **Ingestion Service:** Handles ingestion of raw data such as PDFs or images and stores them in S3.
- **Report Service:** Generates structured, formatted reports from processed and analyzed data.
- **Q&A Service:** Manages interactive question-and-answer exchanges with the AI.
- **Auth Service:** Provides authentication and authorization for users, ensuring secure access and operations.

## 3. Communication Layer

This layer facilitates efficient communication and coordination among microservices.

- **RPC Server:** Enables direct service-to-service communication via Remote Procedure Calls.
- **Cache:** A high-speed memory layer that stores frequently accessed data to optimize performance.
- **Event Broker / Message Queue** (RabbitMQ or Kafka): Handles asynchronous communication and event-driven processing across services, ensuring reliability, scalability, and robust monitoring.

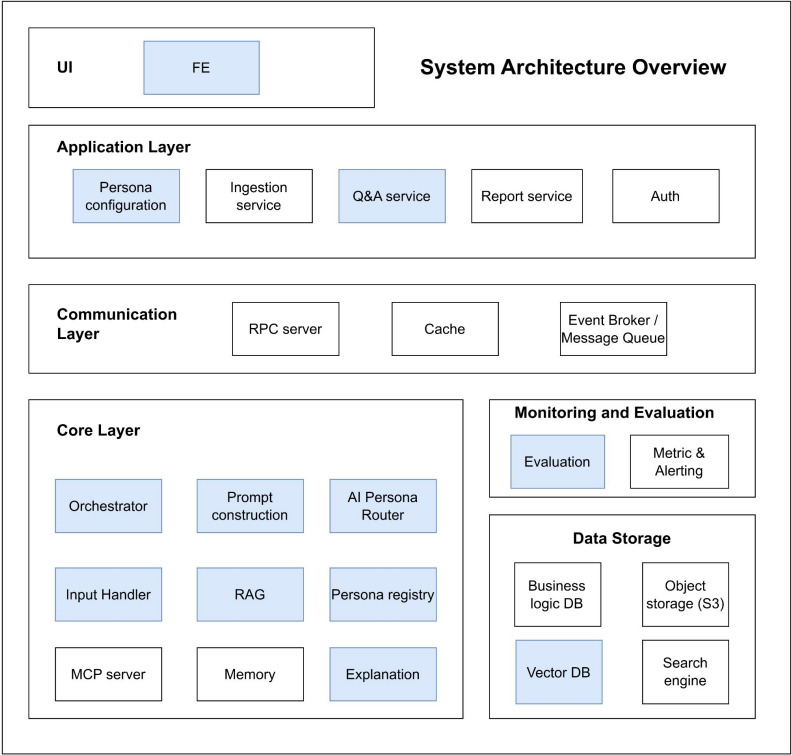


# Design

## 4. Core Layer

The intelligence engine of the system—handles AI persona logic, LLM orchestration, and data-driven grounding.

- **Orchestrator:** The central coordinator of the Core Layer. When a request arrives, the Orchestrator manages the entire generation process, directing which services to call.
- **Input Handler:** Preprocesses and normalizes user inputs, including text extraction from PDFs and preparation of image data for AI analysis.
- **Prompt Construction:** Dynamically builds structured prompts by combining user input, persona rules, and retrieved data.
- **AI Personas:** Represents the fine-tuned Large Language Models (LLMs) tailored to embody distinct customer segment personalities.
- **RAG (Retrieval-Augmented Generation):** Provides factual grounding by retrieving relevant information from the Vector DB, ensuring responses remain accurate.
- **Persona Registry:** Stores the static attributes and behavioral definitions of each persona, guiding prompt construction and response tone.
- **Explanation:** This module allows for an in-depth explanation of the thought process behind the reasoning model and the data used in the thinking process.
- **MCP Server (Model Context Protocol Server):** Enriches LLM interactions with real-time contextual or external domain data.
- **Memory:** It stores the recent history of the user's chat, allowing the persona to remember what was said earlier in the conversation and provide context-aware answers.



# Design

## 5. Monitoring and Evaluation

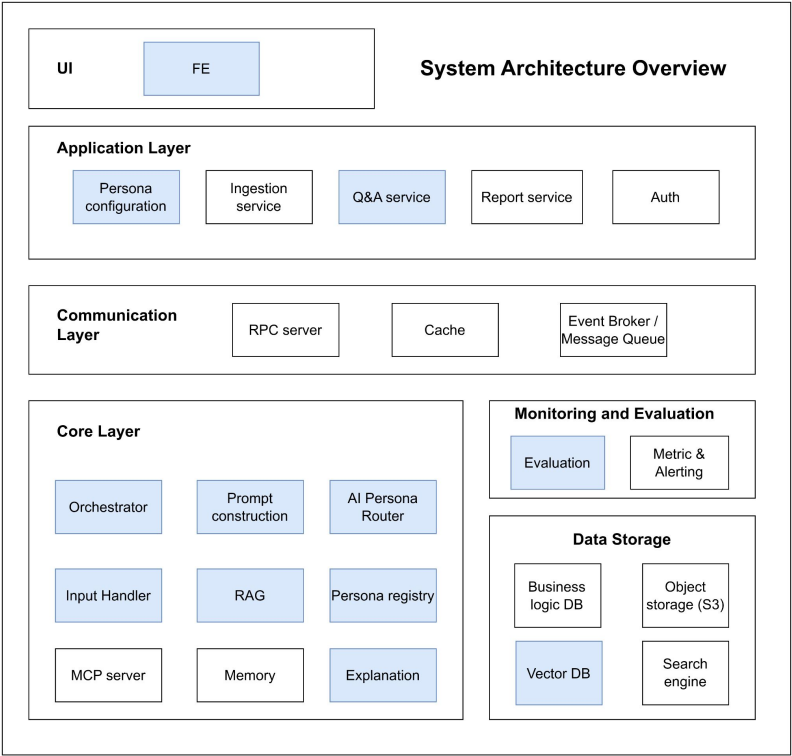
A centralized observability layer that tracks performance, quality, and reliability across all services.

- **Evaluation Tools:** Measure the accuracy and quality of AI responses and data processing outcomes.
- **Metrics & Alerting:** Monitor key indicators such as latency, error rates, resource utilization, and token usage, triggering alerts for anomalies or system degradation.

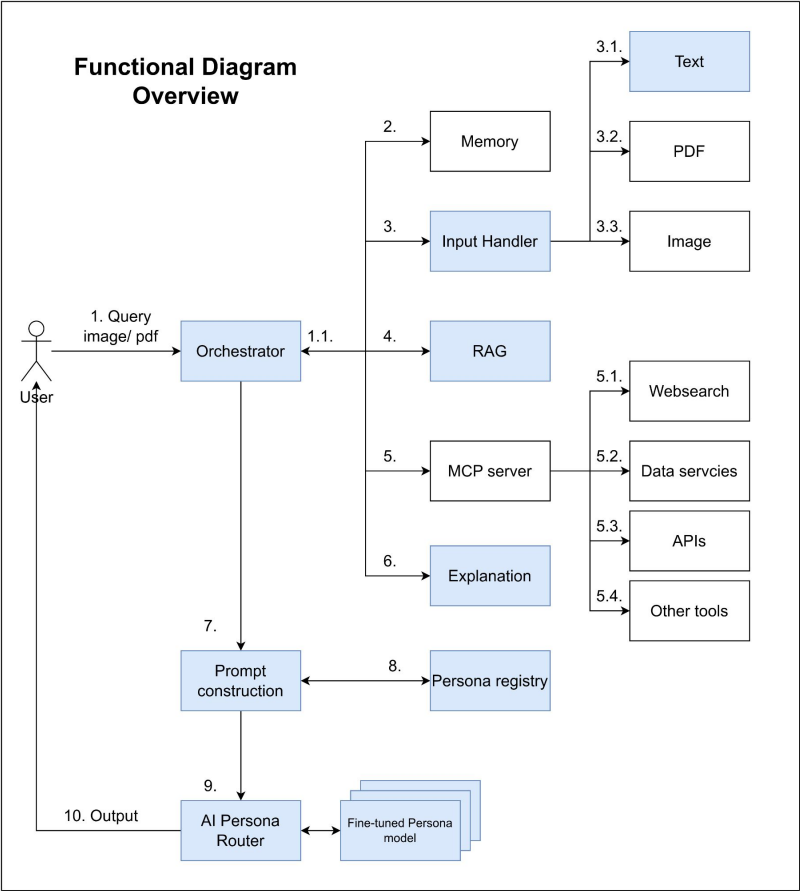
## 6. Data Storage Layer

The persistence foundation of the system, designed for scalability, durability, and speed.

- **Business Logic Database:** Stores structured data such as user profiles, authentication records, saved reports, and persona definitions.
- **Object Storage (S3):** Manages large, unstructured data files (e.g., raw PDFs, images, and uploaded datasets).
- **Vector Database:** Stores embeddings for persona-related documents, historical interactions, and reference materials — powering RAG retrieval and factual grounding.



# Design



**1. User Query Submission:** User sends a query with optional attached files (image, PDF, etc.) to the Orchestrator.

**1.1 Orchestrator Analysis:** The Orchestrator analyzes the query and attachments to decide which services should be used.

**2. Memory Integration :** Extract useful information from chat history.

**3. Input Preprocessing:** Inputs are preprocessed before passing to the model.

**3.1 Text Input:** Normalize text to make it easier to handle in later steps.

**3.2 PDF Input:** Parse, process, and extract meaningful information from PDF files.

**3.3 Image Input:** Process images and extract valuable information.

**4. Context Retrieval (RAG System):** Use the query and relevant input information to retrieve context (e.g., market data) via a RAG system.

**5. Tool Selection & MCP Server Requests**

- Decide which tools should be used to enrich the context.
- Send requests to the MCP server to gather corresponding context.

**5.1 Web Search:** Extract updated information from the internet (trends, real-time data, missing internal data, etc.).

**5.2 Database Query:** Retrieve useful data from internal or external databases.

**5.3 External APIs:** Call APIs to obtain additional information.

**5.4 Other Tools:** Use calculators, simulators, weather data extractors, or other utilities to enrich context.

**6. Explanation:** The explanation module will explain in detail the thought process of the reasoning model and the data used for the thinking process.

**7. Prompt Construction:** The Orchestrator aggregates useful context and passes it to Prompt Construction.

**8. Persona Selection :** Apply the selected Persona profile, including: Demographics, Behavior Data, Transactional Data, ...

**9. Persona Model Routing**

- Route to a fine-tuned Persona model.
- Pass the enriched prompt and context.

**10. Model Response:** Generate a response with: Specific personality, Tone, Linguistic style of the Persona

# AI Personas Extraction & Fine-Tuning

## Indicators (VLLM extraction output)



### Example indicator shape (JSON):

```
{
  Indicator: {
    sources: {
      "url": {"https://www.pclavazza.com/nead/20/Indicator"}
    },
    statements: {
      'statement': individual insights within an indicator, sostons and influences'},
      'metrics' {'marks whethr a svisually emphasiz: 'index', '%', 'count', 'rank'},
      'influene': flags whether a statement shapes tone or stance, 'smex': 'sources'}
    }
  }
}
```



# AI Personas Extraction & Fine-Tuning

## Traits (reasoning output)

### Persona Blueprint (Traits)



#### style\_profile

🗨️ **how they speak:** tone, formality, directness, emotional flavour, criticality, verbosity, preferred structures, example phrases.



#### value\_frame

⚖️ **what they prioritize:** priority\_rank (sustainability, price, etc.), novelty seeking, brand loyalty, health concern, description.



#### reasoning\_policies

⚙️ **purchase\_advice, product\_evaluation, information\_processing, content\_filters** (biases, rules, praise/criticism triggers, trust, disclaimers).

### Example JSON Structure



```
// How the model should "speak"
style_profile: {
  tone_adjectives: string[], // ["Curious", "confident", "quality-focused", "pragmatic", ...],
  formality_level: "low" | "medium" | "high",
  directness: "very_direct" | "balanced" | "hedged",
  emotional_flavour: "neutral" | "enthusiastic" | "cool_detached" | "warm_reflective",
  criticality_level: "high" | "medium" | "low",
  verbosity_preference: "concise" | "detailed" | "varies_by_question",
  preferred_structures: string[], // ["bullet_point", "clear_rsadeoffs", "pros_cons", "step_by_step"]
  typical_register_examples: string[] // short example phrases in target style
},

// What they care about – used to biss recommendations / reasoning
value_frame: {
  priority_rank: string[], // e.g. ["quality", "convenience", "sustainability", "price"],
  sustainability_orientation: "high" | "medium" | "low",
  price_sensitivity: "high" | "medium" | "low",
  price_sensitivity: "high" | "medium" | "low",
  novelty_seeking: "high" | "medium" | "low"
},
}
```



# Design - Risks Analysis

## Technical Risks

- Hallucinations and inaccurate responses: mitigate with RAG system
- Insufficient critical thinking: mitigate with RAG and prompt engineering
- Opacity: mitigate with RAG
- Inconsistent or generic personality: mitigate by fine-tuning (in case of limited resource use PEFT, smaller models, RAG with few-shot prompting)
- Performance evaluation difficulty





# Design - Risks Analysis

## Governance and Security Risks

- Privacy and compliance with AI Act and GDPR
- Proprietary data protection
- System integration difficulty with existing systems and infrastructure





# Design - Risks Analysis

## Data and Other Risks

- Data integration difficulty
- Data quality and bias
- Over relying on AI Personas

