AI-Driven Financial Report Analysis System

# 1. Problem and AI-based Solution

Financial documents like annual reports, balance sheets, and earnings reports contain valuable insights but are often long, complex, and filled with financial jargon and data. Manually extracting key points is time-consuming and error-prone.  
  
To address this, we propose an AI-based system capable of analyzing both textual and image-based financial content. It extracts relevant financial metrics, analyzes charts and images, and summarizes insights contextually for stakeholders such as investors, auditors, and financial analysts.

# 2. Architecture and Tools Used

The system architecture consists of the following components:  
  
- \*\*LangChain\*\*: For orchestrating LLM-based tasks such as retrieval and question answering.  
- \*\*Google Gemini or OpenAI GPT-4o\*\*: As the large language model (LLM) to process extracted data and generate insights.  
- \*\*PDF/Image Loader (PyMuPDF + PIL)\*\*: To parse and extract images and text from financial PDFs.  
- \*\*Embeddings (e.g., OpenAI or Gemini Embeddings)\*\*: To convert chunks into vector representations.  
- \*\*Vector Store (e.g., FAISS)\*\*: For storing embeddings and enabling semantic search.  
- \*\*Retriever & Prompt Template\*\*: To allow query-based insights with context-aware responses.

# 3. Implementation Steps

1. \*\*PDF Loading\*\*: The PDF is read using PyMuPDF to extract text and images.  
2. \*\*Chunking\*\*: The document text is broken into smaller overlapping chunks for embedding.  
3. \*\*Embedding\*\*: Each chunk is converted into a vector using embedding models.  
4. \*\*Vector Store\*\*: Chunks are stored in a FAISS index for fast similarity search.  
5. \*\*Image Handling\*\*: Financial tables/charts are extracted using PIL and optionally passed with OCR/vision-based prompts.  
6. \*\*Retrieval and QA\*\*: LangChain retrieves the top-k relevant chunks/images for a user query.  
7. \*\*Answer Generation\*\*: Gemini/OpenAI generates an insightful, context-aware answer.

# 4. Sample Questions and Answers

\*\*Q1: What was the Net Profit in the latest quarter?\*\*  
A: EUR 690 million, down from EUR 759 million in Q3 2023.  
  
\*\*Q2: What are the key highlights from the balance sheet?\*\*  
A: Total Assets: EUR 403.8B, Loans to Customers: EUR 259.6B, Client Deposits stable at EUR 224.5B.  
  
\*\*Q3: Are there any risks or outlooks mentioned?\*\*  
A: Risks include Basel IV regulatory impacts. Management postponed capital assessment to Q2 2025. Outlook remains positive due to a strong housing market and digital innovation.

# 5. Reflections on Accuracy, Limitations, and Improvements

\*\*Accuracy\*\*: High-quality results depend on OCR accuracy for image-based data and well-formulated prompts for LLMs.  
  
\*\*Limitations\*\*:  
- Vision-based insight extraction still relies on model capabilities to interpret graphs and complex tables.  
- Highly domain-specific jargon may lead to hallucinated answers without proper grounding.  
  
\*\*Future Improvements\*\*:  
- Integrate multi-modal LLMs (e.g., Gemini Pro Vision) for deeper visual+text analysis.  
- Expand domain-specific fine-tuning for financial terminology and regulation.

# 6. Conclusion

This AI-driven financial analysis system demonstrates the potential of combining text understanding, vision models, and retrieval-augmented generation to reduce the manual effort in analyzing complex financial documents. It provides fast, accurate, and actionable insights that enable better decision-making for financial professionals.

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