Kaggle Competition "Drawing with LLMs"

Systems Analysis and Design

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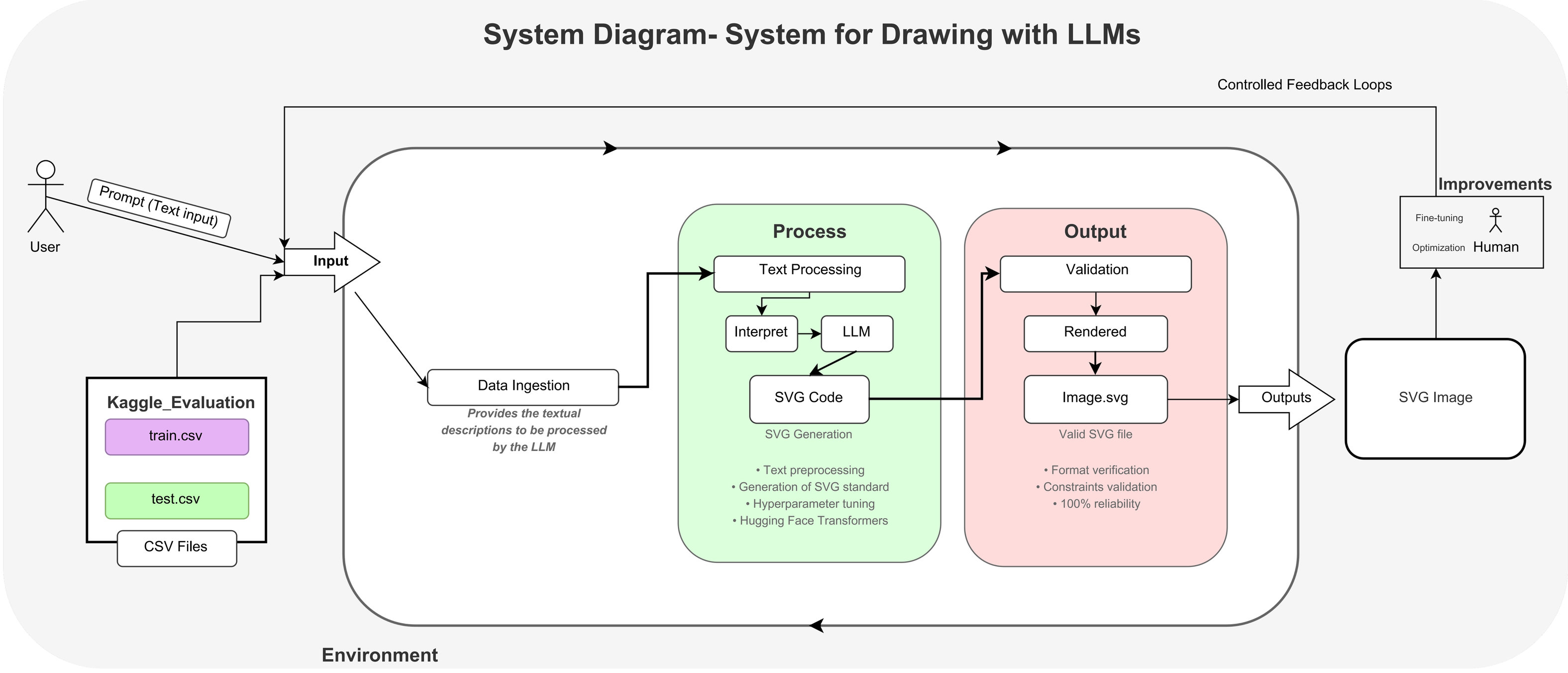
Introduction

The central challenge of Kaggle's "Drawing with LLMs" competition is to generate Scalable Vector Graphics (SVG) images from textual descriptions (prompts) using Large Language Models (LLMs). This task lies at the intersection of Natural Language Understanding (NLU), automatic code generation, and computer graphics synthesis, presenting significant systemic complexity as it involves an open system that must interact with diverse inputs and external evaluation criteria. Existing solutions often struggle with semantic consistency between the prompt and the SVG, the syntactic validity of the generated SVG, and robustness to ambiguous or novel input. Key challenges include ensuring accurate prompt interpretability, controlling the inherent variability of LLMs, and guaranteeing the quality and validity of the resulting SVG.

Proposed Solution



A modular, layered architecture is proposed with a well-defined data processing workflow: **Input (Prompt Ingestion and Preprocessing) → Process (Semantic Interpretation, LLM Generation, Parameter Control) → Output (SVG Validation, Postprocessing, Persistence).** This design promotes separation of concepts, high cohesion, and loose coupling.

Goal

Research Question: How can a robust, modular, and efficient system architecture be designed that effectively translates textual descriptions into visually coherent and syntactically valid SVG representations, proactively managing the sensitivity and emergent behaviors associated with LLMs?

Implementation and Validation Plan

Phase	Main Activities	Validation Objective
1. Initialization and Prototyping	Environment setup, development of a simple, accessible, basic minimal prototype.	Validate technical feasibility of the main flow.
2. Development of Central Modules	Robust implementation of ingestion, preprocessing, LLM core, and SVG postprocessing. Unit testing.	Ensure functional processing chain and ability to generate valid SVGs for diverse prompts.
3. Robustness and Quality	Refinement of advanced prompt engineering, implementation of sensitivity/chaos management strategies. Development of internal quality assessment. Structured logging.	Significantly improve the quality, reliability, and predictability of SVGs.
4. Optimization and Documentation	Performance optimization. Scalability testing simulating competitive loads. Comprehensive documentation.	Functionally complete, optimized and documented system.
5. Final Testing and Packaging	Execution of a complete test plan (functional, performance, robustness) with validation datasets. Bug fixes.	Maximum system quality and compliance with Kaggle guidelines.

Expected Success Criteria

Expected Strengths:

- **High Reliability:** 100% syntactically valid SVGs.
- **Improved Semantic Coherence:** Thanks to prompt engineering and LLM control.
- **Robustness:** Predictable handling of anomalous inputs and failures.
- **Maintainability and Scalability:** Modular design.

Potential Weaknesses/Challenges:

- **Generation Latency:** The target of <1s (NFR1) is ambitious and depends on the complexity of the LLM and SVG.
- **Inherent Ambiguity:** Interpreting highly abstract or subjective prompts will remain a challenge.
- **Dependency on External LLMs:** If APIs are used, availability and changes to the base models may be impacted.

Conclusions

The proposed system design addresses the goal of creating a robust and efficient solution for generating SVGs from text using LLMs. The research question is addressed through a modular architecture, explicit strategies for managing sensitivity and chaos, and an iterative implementation plan.

While the goal of generating perfect, highly creative SVGs from any prompt remains a longshot in AI, this design lays the groundwork for a competitive, maintainable, and adaptable system .

Main Bibliography:

[1] Kaggle. (n.d.). Drawing with LLMs. https://www.kaggle.com/competitions/drawing-with-llms/overview
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[3] W3C. (2011). Scalable Vector Graphics (SVG) 1.1 (Second Edition). https://www.w3.org/TR/SVG11/