Software Design Specification

UI/UX Automation Using LLM

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Project Manager's Signature

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Definition of Terms, Acronyms and Abbreviations

Term	Description
LLM	Large Language Model, used for generating designs and contextual suggestions.
GraphRAG	Graph-based Retrieval-Augmented Generation for contextual responses.
OWL	Web Ontology Language for semantic consistency.
Neo4j	Graph database used for storing and querying UI/UX design knowledge.
UI	User Interface.
UX	User Experience.
Figma	Collaborative design tool for exporting high-fidelity designs.

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1. Introduction

1.1 Purpose of Document

This document specifies the software design for the **UI/UX Automation Using LLM** project. It establishes a blueprint for the system's development, ensuring adherence to the defined requirements and delivering a scalable and efficient product. The audience includes stakeholders, system architects, developers, and QA teams.

1.2 Project Overview

The project leverages **Large Language Models (LLMs)** to automate UI/UX workflows, enabling seamless wireframe generation, validation, and export. Integration with Neo4j for knowledge graphs and OWL for ontologies ensures adherence to UI/UX standards.

Key Features:

- Automated wireframe generation from natural language descriptions.
- Context-aware design validation using OWL-defined principles.
- Export functionality to Figma for high-fidelity design outputs.
- AI-driven design suggestions based on industry trends.

1.3 Scope

In-Scope:

- Automating design workflows for UI/UX designers.
- Providing intuitive feedback for improvement.
- Knowledge graph management and updates for scalable usage.

Out-of-Scope:

- Prototypes with interactive elements.
- Domain-specific UI/UX needs outside the ontology's scope.

2. Design Considerations

2.1 Assumptions and Dependencies

Assumptions:

- Users are proficient in basic UI/UX principles and tools like Figma.
- Internet connectivity will be reliable for LLM and knowledge graph queries.
- APIs (OpenAI, Figma) remain stable and accessible throughout development.

Dependencies:

- **LLM APIs:** Dependence on services like OpenAI for processing natural language.
- **Neo4j Database:** Ensures efficient knowledge storage and querying.
- **Cloud Infrastructure:** Hosting for scalability and consistent performance.
- **Ontology Updates:** Regular maintenance required for industry-relevant suggestions.

2.2 Risks and Volatile Areas

- **Evolving Standards:** Changing UI/UX trends may necessitate updates to ontologies and suggestions.
- **API Downtime:** Dependence on third-party APIs may lead to disruptions.
- **Scalability Concerns:** High user demand could affect system performance if not optimized.
- **Data Security:** Protecting sensitive design data and adhering to regulations like GDPR is critical.

3. System Architecture

3.1 System Level Architecture

The system is organized into three primary layers:

Presentation Layer:

- User-facing interface for accessing features.
- Includes functionalities like design input, wireframe generation, and validation feedback.

Business Logic Layer:

- Handles core workflows including GraphRAG-based design generation.
- Interacts with the ontology for design validation.

Data Layer:

- Manages Neo4j-based knowledge graphs and data persistence.

3.2 Sub-System / Component / Module Level Architecture

Wireframe Generation Subsystem:

- Converts textual design requirements into structured wireframes using LLM and GraphRAG.

Design Validation Subsystem:

- Validates wireframes against UI/UX principles.
- Suggests improvements for usability and alignment.

Feedback Subsystem:

- Provides actionable design insights based on contextual queries.

Export Subsystem:

- Enables seamless export of designs to Figma.

3.3 Sub-Component / Sub-Module Level Architecture (1…n)

- **Wireframe Generator:** Handles LLM queries and graph-based suggestions.
- **Validator:** Ensures compliance with UI/UX principles.
- **Knowledge Graph Manager:** Updates and retrieves data from Neo4j.
- ***Exporter:*** *Converts wireframes into Figma-compatible formats.*

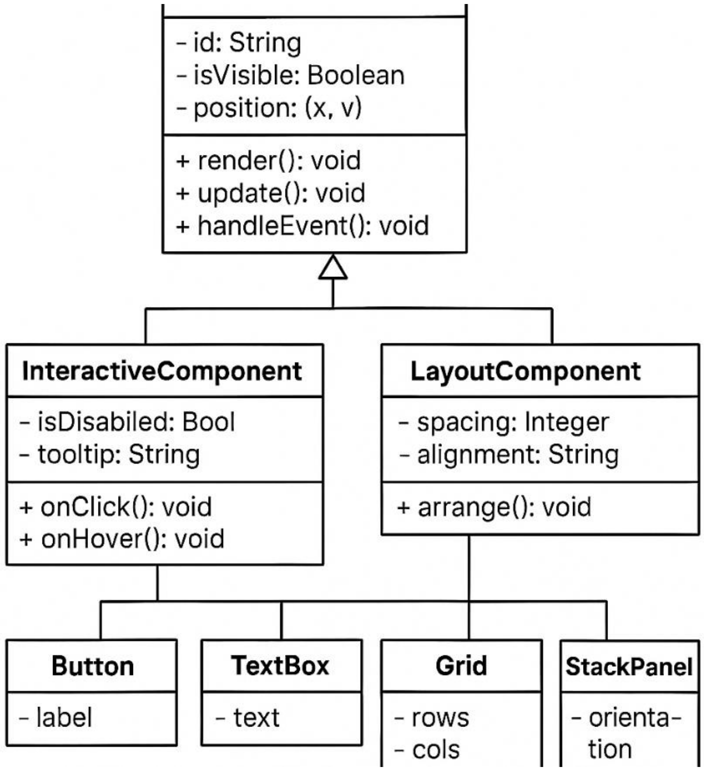
4. Design Strategies

4.1 Strategy 1…n

- **Scalability:** Modular components for future enhancements.
- **Data Reuse:** Centralized knowledge base with reusable components.
- **Cross-Platform Accessibility:** Responsive design for web and mobile interfaces.
- **Performance Optimization:** Asynchronous processing for efficient LLM queries.
- ***Security Measures:*** *End-to-end encryption and role-based access.*

5. Detailed System Design

5.1 Class Diagram:



- **UIComponent (abstract base)**
- **Attributes**

id: String — unique identifier

isVisible: Boolean — whether component is drawn

position: Point — 2D coordinates on screen (e.g. { x: 100, y: 50 })

- **Methods**

render(): actually draws the component if isVisible == true.

update(): recalculates any internal state (e.g. after property changes).

handleEvent(evt: Event): default dispatcher that routes events down to specialized handlers (e.g. click, hover).

InteractiveComponent (inherits UIComponent)

- **Attributes**

isDisabled: Boolean — if true, ignores input events

tooltip: String — text shown on hover

- **Methods**

onClick(evt: MouseEvent): called by handleEvent when a click occurs within bounds and !isDisabled.

onHover(evt: MouseEvent): called when the pointer enters/leaves; may show/hide tooltip.

Interaction:
UIComponent.handleEvent checks event type; if evt is click or hover and this is an InteractiveComponent, it down-casts and calls onClick/onHover.

LayoutComponent (inherits UIComponent)

- **Attributes**

spacing: Integer — pixel gap between children

alignment: Alignment — e.g. LEFT, CENTER, RIGHT

children: List<UIComponent> — contained components

- **Methods**

arrange(): computes and sets each child's position based on spacing & alignment.

add(child): appends a child and calls arrange().

remove(child): removes and re-arranges.

Interaction:
When you call layout.arrange(), it iterates over children, invokes each child's update(), then places them in a grid or stack depending on subclass.

Button (inherits InteractiveComponent)

- **Attributes**

label: String — text drawn inside the button

- **Methods**

click(): public API to programmatically trigger onClick.

(Inherited) onClick: typically raises a "clicked" event to application logic.

TextBox (inherits InteractiveComponent)

- **Attributes**

text: String — current content

- **Methods**

setText(value): updates text and calls update().

clear(): sets text = "".

Grid (inherits LayoutComponent)

- **Attributes**

rows: Integer — number of rows

cols: Integer — number of columns

- **Methods**

getCell(r, c): returns the component at row r, column c (or null).

Interaction:

Grid.arrange() divides its own bounding box into rows × cols cells, places each child in sequence or by explicit row/col metadata.

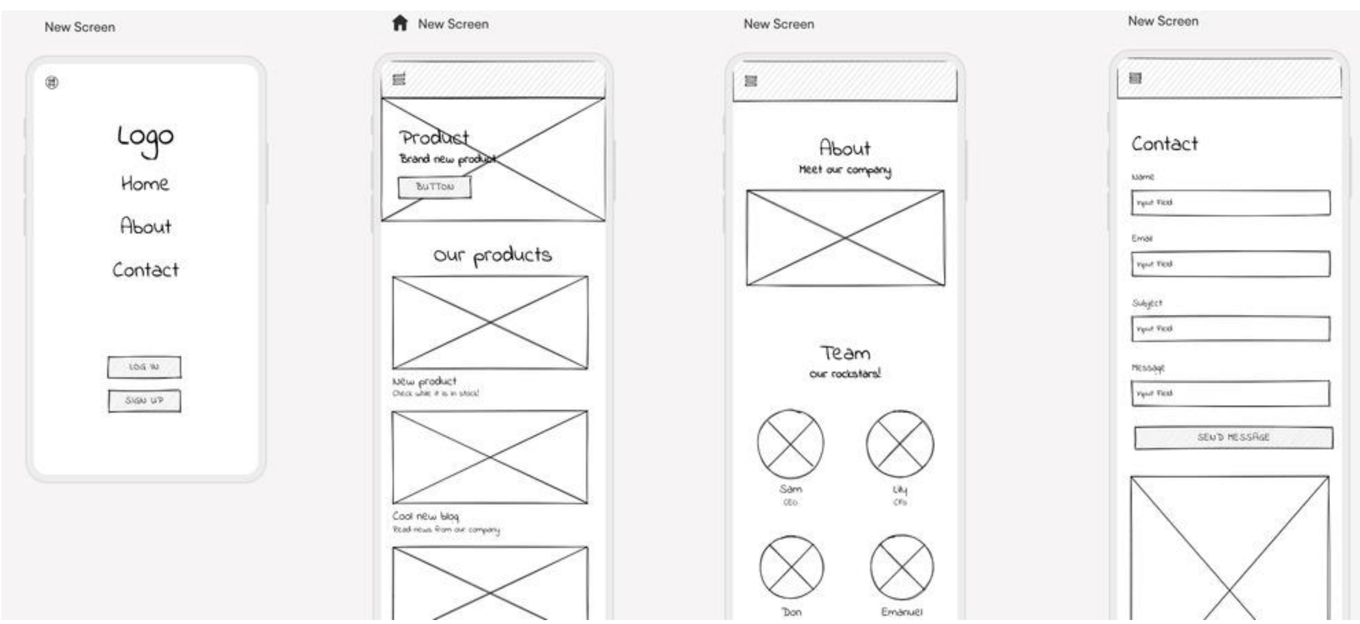
StackPanel (inherits LayoutComponent)

- **Attributes**

orientation: Orientation — either HORIZONTAL or VERTICAL

Interaction:
StackPanel.arrange() lines children up in a row or column, spacing them by spacing, and aligning them according to alignment.

Sequence Diagram:



This sequence diagram lays out the step-by-step flow for automatically generating a styled wireframe and pushing it into Figma:

Prompt & Context

- The Designer starts by sending a natural-language prompt (e.g. "Recipe page for food app") to the Wireframe Generation Service.

Raw Wireframe Generation

- The Wireframe Service invokes its fine-tuned LLM (trained on UI patterns) to produce a raw wireframe model—a structured JSON or UI tree defining containers, text blocks, image slots, and interactive elements.

Beautification

- The Designer then calls the Beautify Engine, supplying the raw model plus any chosen design tokens or platform rules.
- The engine consults its styling rules (spacing scales, typography, color palettes) and returns a polished mid-fidelity mockup in vector or HTML/CSS form.

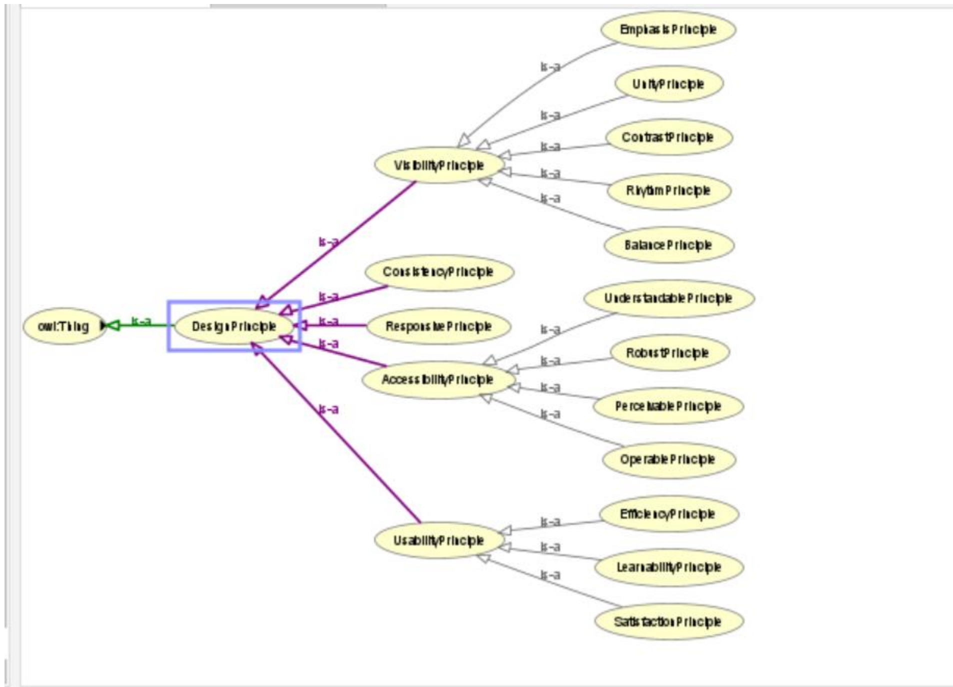
Export to Figma

- With the styled screens approved, the Designer triggers the Figma Exporter, sending over the vector assets along with layer and component metadata.
- The exporter uses the Figma API (or a plugin) to recreate each screen as native Figma frames, groups, and symbols.

Completion

- Figma responds with confirmation and provides a shareable link (or embeds the new pages in the existing project), making the wireframes instantly available for collaborative editing, annotation, and hand-off.

State Transition Diagram:



Input stage:

- The "owlThing" node on the far left represents the entry point where design requirements would be processed into the system.

Generated stage:

- The "DesignPrinciple" central node represents the core principles that the LLM would apply when generating wireframes from user input.

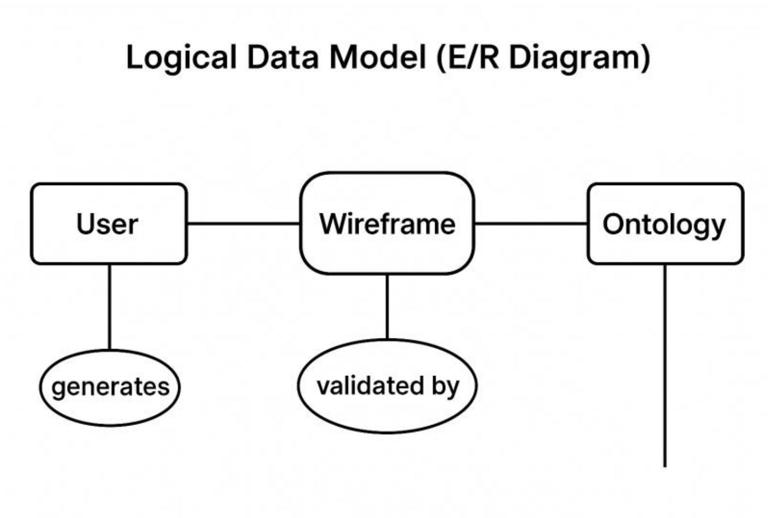
Validated stage:

- This is where the diagram is most relevant, showing the extensive validation framework:
- Major principles like Visibility, Consistency, Responsiveness, Accessibility, and Usability branch out
- Each major principle further connects to specific sub-principles (is-a relationships)
- For example, Visibility connects to Emphasis, Unity, Contrast, Rhythm, and Balance
- Accessibility connects to Understandability, Robustness, Perceivable, and Operable

Exported stage:

- While not explicitly shown, the wireframe would only proceed to export after validation against this comprehensive set of principles.

Logical Data Model (E/R Diagram):



Entities:

- **User**
- Represents individuals who interact with the system.
- Likely attributes: UserID, Name, Email, etc.

Wireframe

- Represents design artifacts or layout structures created within the system.
- Likely attributes: WireframeID, Title, CreationDate, etc.

Ontology

- Represents a structured set of rules or semantic constraints used to validate wireframes.
- Likely attributes: OntologyID, RuleName, Description, etc.

Relationships:

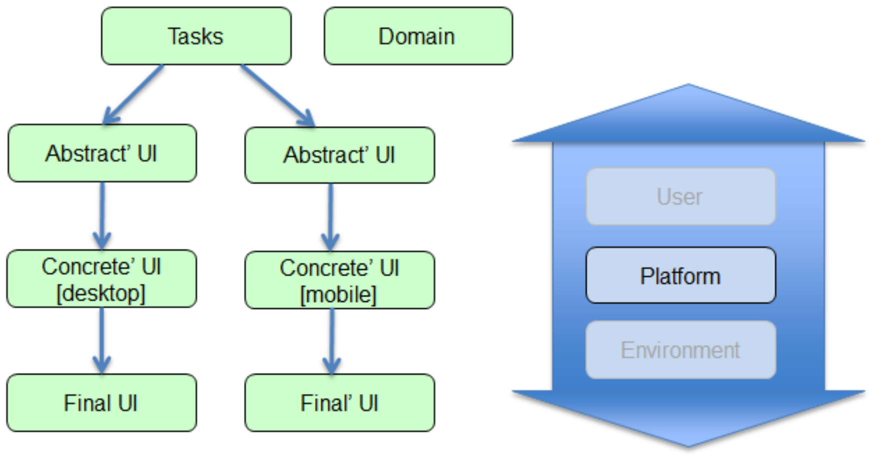
User "generates" Wireframes

- A one-to-many relationship: each user can generate multiple wireframes.
- Typically implemented by associating UserID as a foreign key in the Wireframe entity.

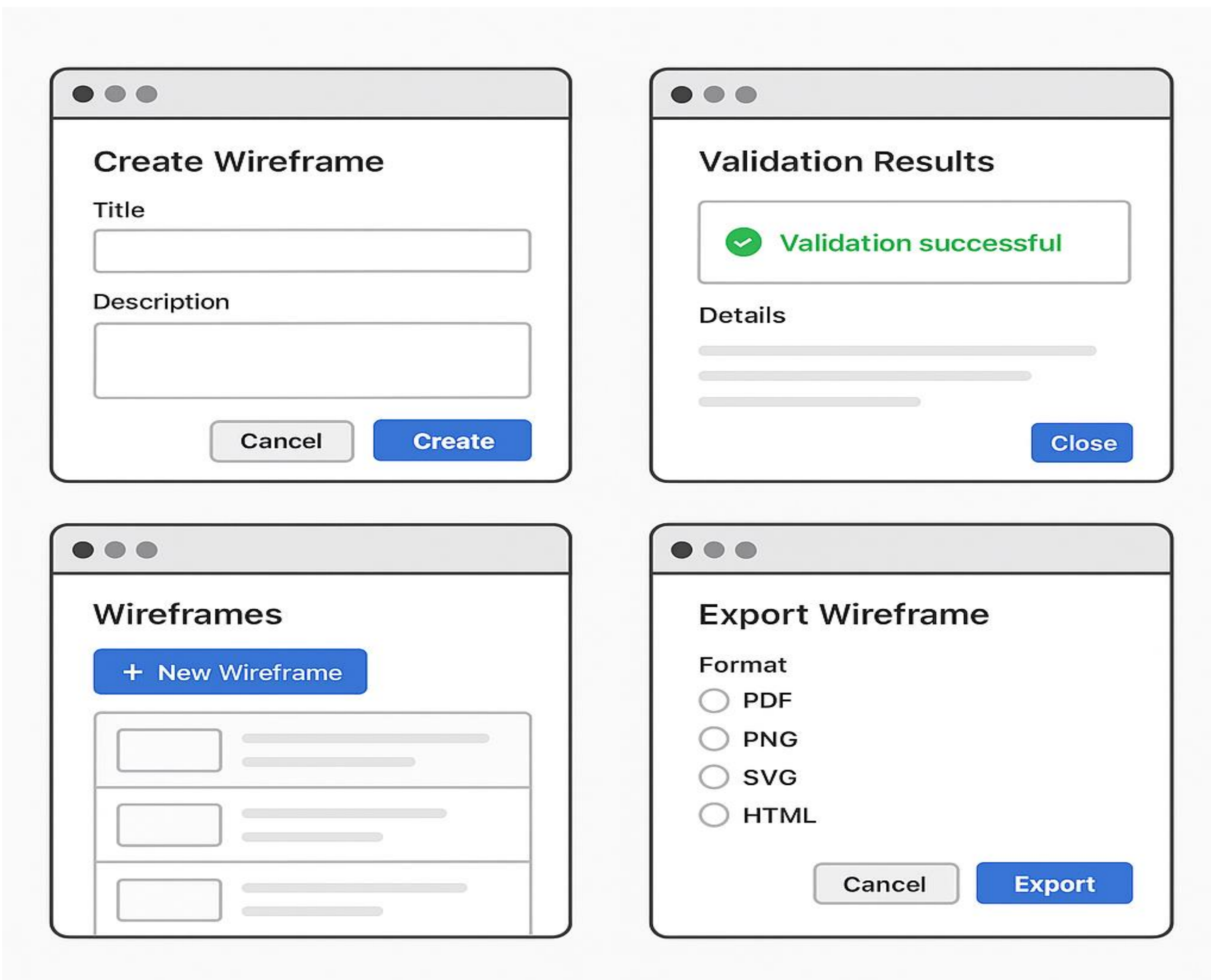
Wireframes "validated by" Ontology

- A many-to-many relationship: each wireframe can be validated by multiple ontology rules, and each rule can validate multiple wireframes.
- This could be represented logically by a linking entity or join table in physical design.

Physical Data Model:



GUI Designs:



6. References

Ref. No.	Document Title	Date of Release/ Publication	Document Source
RAG2023	GraphRAG Explained: Enhancing RAG with Knowledge Graphs	2023	Medium (https://medium.com/@zilliz_learn/graphrag-explained-enhancing-rag-with-knowledge-graphs-3312065f99e1
OWL2004	OWL Reference	Feb 10, 2004	W3C (https://www.w3.org/TR/ owl-ref/)
AIUX2023	Artificial Intelligence (AI) for User Experience (UX) Design	Aug 2023	Information Technology and People Journal

7. Appendices

Appendix

A:Glossary

Appendix B: Workflow Diagrams