LawDigitalTwin: A Proactive and Emotionally Aware Digital Agent for Complex Commercial Disputes

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Abstract

The resolution of modern commercial disputes, particularly those involving intertwined issues like supply chains and financial factoring, poses significant challenges due to their complexity and tight coupling with business operations. We introduce LawDigitalTwin, a proactive and emotionally aware digital agent designed to navigate the entire lifecycle of complex commercial disputes. Unlike traditional legal solutions that focus solely on question-and-answer interactions, our system leverages Large Language Models (LLMs) to integrate a structured legal workflow, offering end-to-end support that encompasses evidence gathering, legal fact summarization, lawyer pairing, and strategic litigation planning. A key innovation of LawDigitalTwin is its ability to dynamically integrate emotional recognition into formal legal reasoning processes, which significantly enhances user trust and engagement. Through a case study of a multi-party dispute regarding a smart device supply chain contract, we demonstrate LawDigitalTwin's capability in deconstructing complexities, formulating effective strategies, and executing essential actions such as asset preservation. This demonstration underscores the potential of AI to transform and democratize access to high-stakes legal services.

Introduction

The digital transformation of the legal profession is accelerating, with AI applications evolving from basic document review and legal search to more sophisticated tasks. The demand of paralegal would be deline due to AI (Hinton 2024). However, a significant gap remains in handling complex, multi-faceted commercial disputes. These cases, such as a broken supply chain contract that subsequently triggers a factoring agreement crisis, involve multiple parties, intertwined legal relationships, and immense time pressure. Traditional legal AI tools, which often operate in silos (e.g., contract analysis, case law search), fail to provide a holistic, guided experience for distressed business owners.

We present LawDigitalTwin, a digital agent that acts as a comprehensive legal companion. Its design is guided by two key principles:

1. Proactive, Workflow-Driven Intelligence: The agent doesn't just react to queries; it proactively guides the user through a structured workflow (law_assistant), intelligently requesting information and evidence to build a robust legal position.

2. Emotionally Aware Interaction: Recognizing the high-stakes and stressful nature of legal disputes, the agent incorporates emotional acknowledgment and support into its dialogue, fostering user cooperation and trust without compromising legal rigor.

Our demo will allow users to interact with LawDigitalTwin using a real-world case, showcasing its ability to distill chaos into a clear, actionable legal strategy.

Architectual Design

As depicted in Figure 1, LawDigitalTwin's architecture is built around a central Orchestrator LLM that manages the interaction flow and integrates several specialized modules.
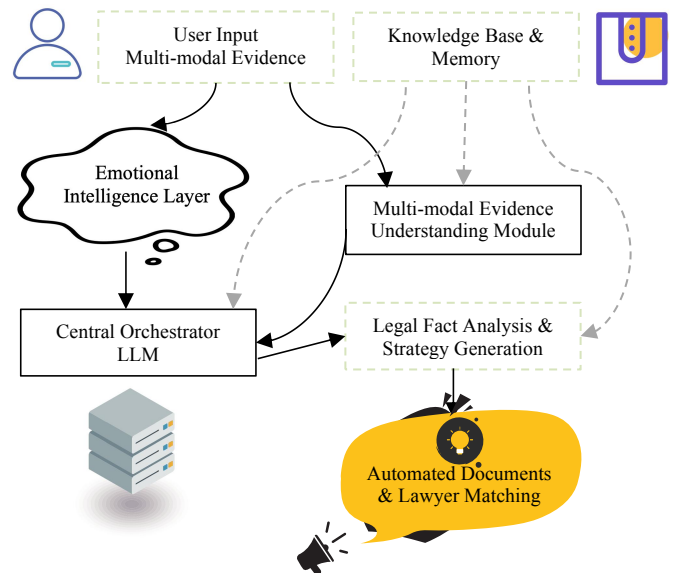

Figure 1: LawDigitalTwin's Architecture.

Core Modules

1. Multi-Modal Evidence Analysis Module: The system supports processing various types of evidence files, such as contracts, chat records, and audio recordings. It extracts key textual information through multimodal technology for subsequent analysis.

2. Structured Workflow Engine: Serving as the core of the system, this engine follows a predefined yet flexible workflow. It guides the user to provide key information in a logical sequence, including the identities of the parties, the domain of the dispute, the case timeline, contractual clauses, evidence and the user's core demands.

3. Emotional Intelligence Interaction Layer: This module identifies emotional cues in the user's input in real-time and adjusts the system's responses accordingly. It incorporates empathetic expressions before posing logical questions, thereby enhancing the user experience and willingness to provide information.

4. Legal Fact Summarization and Document Generation Module: After collecting sufficient information, the system automatically generates a structured legal fact summary. This document clearly outlines the parties involved, legal relationships, timeline, key evidence, and loss calculations related to the case.

5. Intelligent Lawyer Matching Engine: Considering the high potential of LLM in judgement prediction task (Wu et. al. 2023), we choose LLM to complete lawyer mathing task. Based on a database of lawyer profiles, the system matches the specific needs of the case with factors such as the lawyers' areas of expertise, past successful cases, and geographical location. It provides a ranked list of recommendations with clear justifications.

Technological Integration

The system is powered by a foundational LLM (e.g., GPT-4, Claude 3, DeepSeek), which is carefully prompted and constrained to operate within the legal workflow. The empathetic tone comes from prompt engineering and a few carefully chosen examples of compassionate legal communication. The document generation and lawyer matching are triggered by the Orchestrator LLM.

Core Technological Breakthroughs

Existing legal AI systems often excel in closed tasks but struggle with open-world, long-cycle, multi-objective complex interactive scenarios. A user facing an urgent commercial dispute needs a partner that understands their situation, proactively guides them to clarify their thoughts, and provides end-to-end solutions, not merely a tool. This demands AI systems with comprehensive capabilities in context awareness, strategic planning, and humanized interaction.

To address this challenge, we propose LawDigitalTwin. The technical breakthroughs of this demo are as follows:

1 Dynamic State Machine Workflow Engine

Traditional chatbots follow either fixed scripts or completely free dialogue, both unsuitable for legal consultation. We innovatively model the legal consultation process as a Dynamic State Machine.

1.1 States and Transitions

Each state represents a specific information-gathering goal. Transitions between states are dynamically determined by the LLM based on the current dialogue context.

1.2 Context-Aware Prompting

We design highly detailed prompt templates for each state, guiding the LLM to ask precise questions within specific contexts.

For example, in the "Analyze Contract Clauses" state, prompts instruct the LLM to focus on key legal elements. At different stages of a legal matter (e.g., initial client intake, negotiations, or trial preparation), the relevant legal issues and the appropriate tone shift dramatically. A generic "helpful assistant" prompt can't adapt the way an experienced lawyer naturally would—it either gives overly broad answers or misses critical nuances. The context-adaptive prompting framework solves this head-on by dynamically guiding the model to focus on the right legal elements and adopt the right communication style for each specific phase.

1.3 Technical Value

This engine solves the challenge of maintaining a structured reasoning path within open-domain dialogue, forming the core of proactive intelligence.

2 Multi-modal Evidence Synergistic Understanding

Legal evidence often exists in multi-modal forms. Our system not only processes various formats but also performs deep relational reasoning.

2.1 Unified Information Extraction

We utilize Vision-Language Models and Automatic Speech Recognition to convert images, audio, and non-standard PDF text into structured textual information.

2.2 Automatic Evidence Chain Construction and Contradiction Detection

All extracted information is fed into a shared "Fact Pool". The LLM, prompted to act as a lawyer performs:

1. Consistency Checking: Comparing facts stated across different evidences. For example, the system successfully identified a direct contradiction between a notarized WeChat chat record and the counterparty's unilateral contract termination notice.

2. Probative Value Assessment: Automatically tagging each piece of evidence and providing legally logical rationale.

2.3 Technical Value

This method achieves a leap from "processing multi-modal data" to "understanding multi-modal facts", providing explainable automated support for legal argumentation.

3 Emotion-Task Decoupled Dialogue Model

In high-pressure legal disputes, user's emotional expressions can disrupt information flow. We design a decoupled model to balance rationality and empathy.

3.1 Architecture

The model contains two parallel processing channels:

1. Task Channel: Focuses on extracting legally relevant facts and information from the user's latest utterance and deciding the workflow state transition.

2. Emotion Channel: Uses a lightweight emotion classifier to analyze the emotional tone of the user's statement. The output is converted into specific empathetic response templates.

3.2 Response Generation

The final system response is a concatenation: [Emotional Support Prefix] + [Task-Oriented Content].

For example, "I can understand that the other party's failure to follow the contract terms must be incredibly frustrating. From a legal perspective, this constitutes a procedural breach. We now need to focus on Clause 2.3 regarding re-inspection...".

3.3 Technical Value

This design ensures emotional support becomes an integrated system feature rather than a disruption, significantly enhancing user experience and system efficiency in high-stress scenarios.

Comparative User Study: LawDigitalTwin vs. General-purpose AI Assistants

We designed a comparative experiment involving 15 participants with legal or business backgrounds (5 per group). After reviewing the same simulated commercial dispute case and multimodal evidence such as contract PDFs, chat record screenshots, and audio recordings, participants engaged in simulated dialogue interactions with LawDigitalTwin, DeepSeek, and Doubao. User ratings on five key dimensions (1-5 scale, 5 being optimal) were collected to evaluate the performance of each model in a realistic scenario. The results demonstrate that LawDigitalTwin outperforms the other models across four dimensions, particularly excelling in Evidence Integration Capability, Practical Value and Lawer Matching.

Evaluation Dimension	LawdigitalTwin	Deepseek	doubao
Evidence Integration Capability	4.5	3.9	4.0
Emotional Support	4.1	3.8	3.9
Practical Value	4.6	3.5	3.3
Legal Comprehension Accuracy	4.0	4.1	4.0
Lawer Matching	4.5	2.3	2.5

Table 1: Comparative Scoring.

Scoring Notes:
• Data sourced from average participant ratings (1-5 scale). The experiment employed a between-groups design to ensure fair comparison.
• Innovations in LawDigitalTwin's dynamic workflow and emotion-task decoupled model enable breakthroughs in both legal professionalism and user experience.

Demo Walkthrough: The Smart Device Supply Chain Case

We will demonstrate LawDigitalTwin's end-to-end capability using a compelling case based on the provided materials. The attendee will witness the agent's interaction from initial user panic to a finalized litigation plan.
Scenario: The user, "Zhizao Xianfeng Tech Co.," is in a crisis: their major client "Hongtu" wrongfully terminated a contract and refused to pay $15M, while their factoring company "Xunjie" is demanding repayment of $20M. The user's initial input is chaotic and urgent.

Step 1: Proactive and Empathetic Information Gathering

The user uploads evidence and states their problem. LawDigitalTwin activates its law_assistant workflow.
Dialogue Flow:
Agent: "I understand this is a difficult situation. Let's start from the beginning. What is your company's name and business?"
User: "We are Zhizao Xianfeng Tech LLC, based in Shanghai, in smart hardware manufacturing (B2B)."
Agent: "Thank you. I can imagine the pressure your team is under. Who is the other party involved?"
... (The agent continues, gathering details on the contract, timeline, and specific breached clauses).
Demo Highlight: The seamless blend of empathetic language ("I can imagine...") with precise, legally-relevant questioning.

Step 2: Evidence Integration and Gotcha Moment

The agent critically analyzes the provided evidence.

User Action: Provides a notarized WeChat chat record where Hongtu's procurement director admits the "fault rate data might include devices from other suppliers".

Agent's Response: The agent immediately recognizes the immense value of this evidence, labeling it as a key piece that "directly refutes Hongtu's quality claim and proves their unilateral termination lacks factual basis". It also notes the evidence's legality due to its notarized status.

Demo Highlight: Showcasing the system's ability to pinpoint a crucial piece of evidence from a large corpus and correctly assess its legal validity and impact.

Step 3: Automated Legal Fact Summarization

After the Q&A phase, the system automatically generates a structured legal document .The summary includes:

• Parties & Legal Relations: Clearly maps the tripartite relationship.

• Timeline: A crisp chronology of key events.

• Loss Calculation: Breaks down the $40M total claim.

• Evidence Analysis: Evaluates each piece of evidence's probative value.

• Legal Issues: Identifies core disputes (e.g., validity of smart contract, abuse of termination right, conditions for factoring company's pledge right).

Demo Highlight: Transforming a chaotic narrative into a clear, lawyer-ready case summary within seconds.

Step 4: Strategic Litigation Planning and Lawyer Matching

The user's goal is litigation. The agent helps formulate a strategy and finds the right lawyers.

User's Stated Strategy: Sue Hongtu (to confirm termination is invalid and demand payment) and counter Xunjie Factoring (arguing conditions for pledge rights are not met).

Agent's Action: The lawyer matching engine queries its database.

Output: A ranked list of lawyers with a justification matrix.

1st Choice: Lawyer Zhang (Zhong Lun): Expert in factoring disputes, with a proven track record in similar cases and local Shanghai resources — ideal for the core financial dispute and urgent asset preservation.

2nd Choice: Lawyer Yu (Jun Run): Specializes in smart contracts, perfectly suited to handle the jurisdictional and validity issues of the Singapore-based smart contract server.

Demo Highlight: Demonstrating practical utility by moving from strategy to execution, providing a concrete, justified next step for the user.

Conclusion and Future Work

As indicated by many researchers that LLM demo development should focus on assisting judicial paper work rather than replacing judicial reasoning (Wang et. al. 2024) , LawDigitalTwin sets a good example that significantly advances the state of legal AI by managing the entire complexity of commercial disputes with both logical rigor and emotional intelligence. We believe this proactive, integrated approach represents the future of AI-powered legal assistance.

In the future, we plan to enhance the system along two main trajectories: technical robustness and empirical validation.

Given the critical need for factual accuracy in legal services, we will implement and study multi-layered hallucination mitigation mechanisms. This includes strengthening the Retrieval-Augmented Generation (RAG) pipeline with traceable source attribution, developing a rule-based and knowledge-graph-grounded fact verification module, and integrating confidence scoring with calibrated uncertainty expression for all legal outputs. These technical safeguards aim to ensure that the system's proactive guidance remains factually reliable and legally sound.

To address the limitation of our initial pilot study, we will conduct a significantly expanded evaluation involving at least 100 participants from diverse legal and business backgrounds. This study will employ a multi-case, cross-scenario design to test the system's generalizability. We will introduce more objective performance metrics, such as task completion accuracy and expert-rated strategy quality, alongside longitudinal user engagement tracking. This rigorous empirical framework will provide stronger statistical evidence for the system's practical value and user experience benefits.

Finally, we aim to integrate more sophisticated predictive analytics and deeper connections with law firm and court e-filing systems.

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