



LEGAL RESEARCHER AI ASSISTANT

UNDERGRADUATE THESIS
Submitted as one of the requirements to obtain
Sarjana Ilmu Komputer

By:
MUHAMMAD REYHAN WINARTO
001202200034

FACULTY OF COMPUTER SCIENCE
INFORMATICS STUDY PROGRAM
CIKARANG
JULY, 2025

SIMILARITY INDEX REPORT

Reyhan - Thesis.pdf

ORIGINALITY REPORT

4%	4%	0%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to President University	2%
2	repository.president.ac.id	1%
3	mx2.wyona.com	<1%
4	mulpix.com	<1%
5	Submitted to Capella University	<1%
6	pshk.or.id	<1%
7	Submitted to Staffordshire University	<1%
8	president.ac.id	<1%
9	docplayer.info	<1%
10	docplayer.net	<1%
11	123dok.net	<1%
12	Submitted to KDU College Sdn Bhd	<1%

13	Moon Ye-Bin, Dongmin Choi, Yongjin Kwon, Junsik Kim, Tae-Hyun Oh. "ENInst: Enhancing weakly-supervised low-shot instance segmentation", Pattern Recognition, 2024	<1%
14	Submitted to Rochester Institute of Technology	<1%
15	Submitted to unibuc	<1%
16	skemman.js	<1%
17	www.slideshare.net	<1%
18	library.binus.ac.id	<1%
19	repository.radenintan.ac.id	<1%
20	contents.meetbsd.ir	<1%
21	balegetwanbwi.blogspot.com	<1%
22	adcolaw.com	<1%

Exclude quotes: On Exclude matches: Off
Exclude bibliography: On

GPT ZERO

 **GPTZero** Version 2025-06-02-base

Reyhan - Thesis.docx - Google Drive.pdf - 7/21/2025

AI Report

We predict this text is

Human Generated

AI Probability

2%

This number is the probability that the document is AI generated, not a percentage of AI text in the document.

Plagiarism



The plagiarism scan was not run for this document. Go to gptzero.me to check for plagiarism.

Reyhan - Thesis.docx - Google Drive.pdf - 7/21/2025

Rynhan

LEGAL RESEARCHER AI ASSISTANT

UNDERGRADUATE THESIS

ABSTRACT

Digital legal research in Indonesia requires faster, more accurate systems to support practitioners in navigating complex regulatory documents. Identifying relevant statutes and drafting or reviewing legal documents remains time-consuming and error-prone due to scattered laws and inconsistent formats. A multi-agent large language model (LLM) system was developed using GPT-4.1 and Gemini-2.5-pro-flash within a retrieval-augmented generation (RAG) framework. LangChain and meta-prompting help structure agent workflows. The system includes three modules: Regulation Retrieval (for finding relevant articles and Pasal to a certain case or issue), Document Drafting (for generating structured contracts), and Legal Review (for highlighting inconsistencies). Law student reviewers confirmed that the Retrieval module consistently cites accurate Pasal and returns relevant statutes. Drafted documents meet basic structural and linguistic standards. This study demonstrates how multi-agent LLM architectures, combined with prompt engineering and RAG, can efficiently support Indonesian legal workflows by automating regulation search, document drafting, and review. These methods can significantly reduce time and effort in legal practice.

Keywords Computational Law · Multi-Agent System · Prompt Engineering · Indonesian Law · Retrieval Augmented Generation

TABLE OF CONTENTS

STATEMENT OF ORIGINALITY.....	i
SCIENTIFIC PUBLICATION APPROVAL FOR ACADEMIC INTEREST.....	ii
ADVISOR APPROVAL FOR JOURNAL/INSTITUTION'S REPOSITORY.....	iii
SIMILARITY INDEX REPORT.....	iv
GPT ZERO.....	v
ABSTRACT.....	vi
DEDICATION.....	vii
ACKNOWLEDGMENTS.....	viii
TABLE OF CONTENTS.....	ix
LIST OF FIGURES.....	xii
LIST OF TABLES.....	xiv
PROPOSAL (F100).....	1
I.1 PROBLEM FORMULATION.....	1
I.1.1 Background of the Problem.....	1
I.1.2 Problem Statement.....	2
I.1.3 Objective.....	2
I.1.4 Problem from a Customer Perspective.....	2
I.2 PROBLEM CONSTRAINT ANALYSIS.....	3
I.2.1 Aspect 1: Economics.....	3
I.2.2 Aspect 2: Technology.....	3
I.2.3 Aspect 3: Usability.....	4
I.2.4 Aspect 4: Regulatory and Ethical Compliance.....	4
I.2.5 Aspect 5: Sustainability.....	4
I.3 PROBLEM FUNCTIONAL ANALYSIS.....	5
I.3.1 Functionalities 1: Legal Researcher.....	5
I.3.2 Functionalities 2: Legal Document Drafting.....	5
I.3.3 Functionalities 3: Contextual Legal Opinion Generation.....	5
I.3.4 Functionality 4: Multilingual Support.....	6
I.4 SOLUTION SELECTION.....	6
I.4.1 Alternative Solution 1.....	6
I.4.2 Alternative Solution 2.....	8
I.4.3 Alternative Solution 3.....	9
I.4.4 Solution Selection.....	11
I.5 SOLUTION USAGE SCENARIOS.....	13
I.6 DEVELOPMENT EFFORT.....	13
I.7 CONCLUSION.....	14

SPECIFICATION (F200).....	15
II.1 EXISTING AND PROPOSED SYSTEM.....	15
II.1.1 Existing Business Process.....	15
II.1.2 Proposed Business Process.....	16
II.2 GLOBAL DESCRIPTION OF THE PRODUCT.....	17
II.2.1 Main Functionality.....	17
II.2.2 User Characteristics.....	17
II.2.3 Constraints.....	18
II.2.4 Product Development Environment.....	18
II.2.5 Product Operational Environment.....	18
II.3 REQUIREMENT ANALYSIS.....	19
II.3.1 External Interface.....	19
II.3.2 Functional Description.....	19
II.3.3 Data Requirement from user's perspective.....	20
II.3.4 Functional Requirement from user's perspective.....	29
II.3.5 Non-Functional Requirement.....	32
II.4 SPECIFICATION TESTING.....	33
SOLUTION (F300).....	40
III.1 ALTERNATIVE SOLUTION DESIGN.....	40
III.1.1 Alternative Solution 1: Fine-tuned LLM.....	40
III.1.2 Alternative Solution 2: Retrieval-Augmented Generation (RAG).....	41
III.1.3 Alternative Solution 3: Multi-Agent System.....	42
III.2 RATIONAL/SYSTEMATIC DESIGN.....	44
III.2.1 Comparison Table.....	44
III.2.2 Quantitative Solution Selection.....	45
III.2.3 Solution Selection.....	48
III.3 HIERARCHICAL/ITERATIVE DESIGN.....	49
III.3.1 Data Flow Diagram.....	50
III.3.2 Interface Information.....	52
III.3.3 Software Engineering Design.....	52
III.3.4 Details of component references and libraries used for this project.....	53
III.3.5 Diagrams.....	54
III.4 VERIFICATION AND PROOF OF DESIGN PROCESS.....	57
III.4.1 Simulation 1 - Supervisor Agent.....	57
III.4.2 Simulation 2 - RAG-based Regulation Retrieval.....	58
III.4.3 Simulation 3 - Legal Document Drafter Agent.....	60
III.5 STANDARDS USED.....	62
III.6 IMPLEMENTATION AND TESTING PLANS.....	64

IMPLEMENTATION (F400).....	66
IV.1 DESIGNS IMPLEMENTATION.....	66
IV.2 PRODUCT DISPLAY.....	75
IV.3 COMPONENT COST ANALYSIS.....	77
IV.4 MANUAL GUIDE.....	78
IV.4.1 System Build (Developer Perspective).....	78
IV.4.2 User Guide.....	81
IV.5 VIDEO DEMONSTRATION.....	95
TESTING AND EVALUATION (F500).....	96
V.1 PROBLEM FORMULATION.....	96
V.2 GLOBAL SPECIFICATION OF PRODUCT.....	97
V.2.1 Main Functionality.....	97
V.2.2 User Characteristics.....	97
V.2.3 Constraints.....	98
V.2.4 Product Development Environment.....	98
V.2.5 Product Operational Environment.....	98
V.3 FUNCTIONAL TESTING.....	99
V.3.1 Problem Functional Analysis Test Result.....	99
V.3.2 Specification Testing Result.....	108
V.3.3 Qualitative Testing.....	130
CONCLUSION.....	132
REFERENCES.....	133

LIST OF FIGURES

Figure	Page
Figure 2.1 Flow diagram of the FIRAC approach on a single legal issue.	15
Figure 2.2 Use-Case Diagram	19
Figure 2.3 Entity Relationship Diagram	20
Figure 2.4 Entity relations with cardinality	27
Figure 2.5 Application context diagram	29
Figure 2.6 Activity Diagram	30
Figure 2.7 Data Flow Diagram	31
Figure 3.1 Diagram of Alternative Solution 1	40
Figure 3.2 Diagram of Alternative Solution 2	41
Figure 3.3 Diagram of Alternative Solution 3	43
Figure 3.4 DFD diagram from high level to low level	50
Figure 3.5 AI Multi Agent Architecture	51
Figure 3.6 Flowchart diagram	54
Figure 3.7 Use case diagram	55
Figure 3.8 Activity Diagram	55
Figure 3.9 Sequence Diagram	56
Figure 3.10 Entity Relationship Diagram	56
Figure 3.11 Gantt Chart of the project	64
Figure 3.12 S-Chart of the Project	65
Figure 4.1 System Structure Diagram	66
Figure 4.2 Flowchart of this project	67
Figure 4.3 ERD of this project	68
Figure 4.4 User Main Page of this project	69
Figure 4.5 Integration Diagram	70
Figure 4.6 Screenshot of Main Product Display	75
Figure 4.7 Deploying the client-side web application on Vercel	78
Figure 4.8 Set up the AI Agent server using LangGraph Platform 1/2	79
Figure 4.9 LangGraph Platform deployment overview 2/2	80
Figure 4.10 Screenshot of User Registration Page	81
Figure 4.11 Screenshot of User Sign-In Page 1/2	82
Figure 4.12 Screenshot of User Sign-In Page 2/2	82

Figure 4.13 Screenshot of Reset Password Page	83
Figure 4.14 Screenshot of the Main Interface	84
Figure 4.15 Chatting with AI ½	85
Figure 4.16 Chatting with AI 2/2	86
Figure 4.17 Copying the AI Response into Clipboard	87
Figure 4.18 Regenerate AI Response	87
Figure 4.19 Sidebar Menu	88
Figure 4.20 Renaming a Conversation Title 1/2	89
Figure 4.21 Renaming a Conversation Title 2/2	89
Figure 4.22 Delete a Conversation 1/2	90
Figure 4.23 Delete a Conversation 2/2	90
Figure 4.24 Uploading Documents 1/2	91
Figure 4.25 Uploading Documents 2/2	91
Figure 4.26 Inference Process	92
Figure 4.27 Result After Inference Process	93
Figure 4.28 Citation in AI Response	93
Figure 4.29 Drafting Document 1/2	94
Figure 4.30 Drafting Document 2/2	94
Figure 5.1 Specification Testing: Retrieval of Relevant Legal Documents 1/2	109
Figure 5.2 Specification Testing: Retrieval of Relevant Legal Documents 2/2	110
Figure 5.3 Specification Testing: Specific Article/Clause Identification	111
Figure 5.4 Specification Testing: Handling Ambiguous Legal Queries	114
Figure 5.5 Specification Testing: Legal Opinion Generation	116
Figure 5.6 Specification Testing: Counterargument and Alternative Analysis 1	118
Figure 5.7 Specification Testing: Counterargument and Alternative Analysis 2	119
Figure 5.8 Specification Testing: Document Revision and Improvement	121
Figure 5.9 Specification Testing: Conversation Flow and Context Retention 1	123
Figure 5.10 Specification Testing: Conversation Flow and Context Retention 2	124
Figure 5.11 Specification Testing: Conversation Flow and Context Retention 3	125
Figure 5.12 Specification Testing: Legal Terminology and Language Appropriateness	127
Figure 5.13 Specification Testing: Response Time and Performances 1	129
Figure 5.14 Specification Testing: Response Time and Performances 2	129

LIST OF TABLES

Table	Page
Table 2.1 User Characteristics	17
Table 2.2 Data Dictionary for Users	20
Table 2.3 Data Dictionary for Messages	21
Table 2.4 Data Dictionary for Chats	21
Table 2.5 Data Dictionary for Votes	22
Table 2.6 Data Dictionary for Documents	22
Table 2.7 Data Dictionary for Suggestions	23
Table 2.8 Entity Table for Users	24
Table 2.9 Entity Table for Document	24
Table 2.10 Entity Table for Suggestion	25
Table 2.11 Entity Table for Chat	25
Table 2.12 Entity Table for Vote	26
Table 2.13 Entity Table for Message	26
Table 2.14 Specification Testing for Retrieval of Relevant Legal Documents	33
Table 2.15 Specification Testing for Specific Article/Clause Identification	34
Table 2.16 Specification Testing for Handling Ambiguous Legal Queries	35
Table 2.17 Specification Testing for Legal Opinion Generation	36
Table 2.18 Specification Testing for Counterargument and Alternative Analysis	37
Table 2.19 Specification Testing for Document Revision and Improvement	38
Table 2.20 Specification Testing for Conversation Flow and Context Retention	39
Table 2.21 Specification Testing for Legal Terminology and Language Appropriateness	39
Table 2.22 Specification Testing for Response Time and Performances	39
Table 3.1 Comparison Table of All Alternative Solutions	44
Table 3.2 Quantitative Solution Selection - Alternative 1	45
Table 3.3 Quantitative Solution Selection - Alternative 2	46
Table 3.4 Quantitative Solution Selection - Alternative 3	47
Table 3.5 Result of Simulation 1	57
Table 3.6 Result of Simulation 2	58
Table 4.1 Component Cost Analysis	77
Table 5.1 User Characteristics	97
Table 5.2 Legal Research Functional Testing 1	98

Table 5.3 Legal Research Functional Testing 2	99
Table 5.4 Legal Research Functional Testing 3	99
Table 5.5 Document Drafting Functional Testing 1	100
Table 5.6 Document Drafting Functional Testing 2	101
Table 5.7 Legal Opinion Generation Functional Testing	102
Table 5.8 Multilingual Support Functional Testing 1	102
Table 5.9 Multilingual Support Functional Testing 2	103
Table 5.10 Multilingual Support Functional Testing 3	104
Table 5.11 Submit legal issues/queries Functional Testing	104
Table 5.12 Provide Relevant Rules/Regulations Functional Testing	105
Table 5.13 Generate Legal Analysis/Opinions Functional Testing	105
Table 5.14 Draft Legal Documents Functional Testing	106
Table 5.15 Search Queries Functional Testing	106
Table 5.16 Additional Reference Material Functional Testing	107
Table 5.17 Supply Legal Data Functional Testing	107
Table 5.18 Request AI Processing Functional Testing	108
Table 5.19 AI Inference Capabilities Functional Testing	108
Table 5.20 Specification Testing: Retrieval of Relevant Legal Documents	109
Table 5.21 Specification Testing: Specific Article/Clause Identification	111
Table 5.22 Specification Testing: Handling Ambiguous Legal Queries	113
Table 5.23 Specification Testing: Legal Opinion Generation	115
Table 5.24 Specification Testing: Counterargument and Alternative Analysis	117
Table 5.25 Specification Testing: Document Revision and Improvement	120
Table 5.26 Specification Testing: Conversation Flow and Context Retention	122
Table 5.27 Specification Testing: Legal Terminology and Language Appropriateness	126
Table 5.28 Specification Testing: Response Time and Performances	128