
DESIGNING A WEB-BASED LIGHT NOVEL APPLICATION WITH AN LLM-POWERED CHATBOT RECOMMENDATION SYSTEM USING SCRUM METHODOLOGY

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ABSTRACT

In the era of the internet's exponential growth, readers are often overwhelmed by the plethora of books available, particularly in the genre of light novels. This research aims to address this issue by developing a recommendation system for light novels, utilizing a chatbot interface. The methodology employed follows the Borg and Gall model, with a focus on research, information collection, planning, and development stages. The research stage involved the use of questionnaires to gather data and analyze the parameters to be used in the recommendation system. The development stage was carried out using the Scrum methodology and the Retrieval Augmented Generation (RAG) approach for the chatbot's functionality. The outcome of this study is a web-based online light novel application and featuring a chatbot conversational recommender system. Through this system, users can access and read light novels online, while also utilizing the chatbot to request novel recommendations. The research findings demonstrate the successful integration of Large Language Model (LLM) technology into the web-based light novel application. The Scrum development approach facilitated efficient system creation, and the RAG-based chatbots are seen as successful in producing recommendations that match user queries based on existing knowledge. Recommendation results are obtained from semantic search and from the ranking vector with the highest score.

Keyword: Chatbot, Conversational Recommender System, Vector Database, Retrieval Augmented Generation, Scrum.

INTRODUCTION

The rapid growth of the internet has led to an explosion of digital content, making it challenging for readers to discover new and relevant books to read (Sarma et al., 2021), such as light novels. Light novels, closely associated with manga, are short prose novels that feature many of the same themes, tropes, and character archetypes often found in manga. They are quick, pulpy reads meant to entertain and provide a welcome escape from reality. However, the vast amount of available content can be overwhelming for readers, especially those new to the genre (Hersani et al., 2022; Rosyad et al., 2023). This necessitates the development of effective recommendation systems to help readers discover light novels that align with their interests (Intan Hervianda Putri et al., 2022).

Recommendation systems in general often utilize content-based filtering and collaborative filtering methods to provide suggestions to users (Akbar et al., 2023; Rosita et al., 2022; Rosyad et al., 2023). Content-based filtering recommends items to users based on the similarity of items, while collaborative filtering generates lists of items similar to

the user's preferences. However, these approaches have associated limitations (Arfisko & Wibowo, 2022; Hakim & Baizal, 2022). For instance, content-based filtering may not offer recommendations to new users, while collaborative filtering can encounter cold start problems for new items without ratings (Hakim & Baizal, 2022; Hui et al., 2022; Zhang et al., 2021). To address these problems, Conversational Recommender System (CRS) has been proposed (Fajari & Baizal, 2022). Recommendations from CRS are based on user preferences, requiring interaction between the user and the system, which can be handled by a chatbot (Fadhullullah et al., 2021).

Technological developments have played an important role in the evolution of Large Language Model (LLM) and chatbots powered by LLM. With the Large Language Model (LLM), chatbots are able to recognize, create, translate, or summarize human text with increasingly sophisticated capabilities. Chatbots built with LLM also perform well and can focus on specific domains (Mansurova et al., 2023). This can help in developing a Conversational Recommender

System chatbot that can provide recommendation results that match user preferences (Feng et al., 2023).

Research conducted by (Hakim & Baizal, 2022) using knowledge-based chatbot for museum recommendation system in Jakarta. The chatbot was designed to understand user messages and provide museum recommendation results that matched user preferences. Further research by (Sari et al., 2021) focused on designing a chatbot with supervised learning for tourism recommendations in Central Java using the extreme programming method. The results indicate that the chatbot runs well and provides tourist recommendations and information to tourists. In another study, (Hersani et al., 2022) designed a web-based book recommendation information system using extreme programming methods. The research resulted in a Share Ur Book website, which can be used to search for books and book recommendations.

Additionally (Mansurova et al., 2023) conducted research on designing an LLM-powered answering question chatbot in a special domain, namely blockchain. The chatbot was developed using the Retrieval Augmented Generation (RAG) method, which utilizes data stored in a vector database to avoid the need for LLM retraining. The resulting chatbot has promising performance improvements in specialized and knowledge-intensive domains. Lastly, (Kurniawati, 2022) focused on implementing scrum in the design of mobile applications for coffee distribution. The research states that scrum can facilitate the adoption of any changes and help produce quality products as needed.

Despite the advancements in chatbot technology and the promising results of various studies, there is still a significant gap in the field of recommendation systems. Specifically, there is a lack of development in chatbots for recommendation systems that utilize Large Language Models (LLM). While LLM have shown great potential in understanding and generating human-like text, their application in recommendation systems, particularly in the context of light novels, remains largely unexplored. This presents a unique challenge and opportunity for researchers and developers to innovate and push the boundaries of what's possible with LLM-powered recommendation systems.

Based on the description above, the author plans to design a web-based light novel application that incorporates a recommendation system with an LLM-powered chatbot. The application will be developed using the scrum method, and the chatbot will be

integrated with RAG. This initiative aims to not only increase interest in reading but also provide tailored light novel recommendations to the public. The research will contribute to the existing literature by proposing a novel approach that leverages advanced technologies to enhance the book discovery process and promote reading habits. Additionally, the study will fill a gap in the research by exploring the potential of LLM-powered chatbots in the development of conversational recommender systems for light novels, addressing the limitations of existing methods and providing a more interactive and user-friendly experience for readers.

RESEARCH METHODOLOGY

In the research conducted, a multi-method approach was employed, integrating both quantitative and applied research methodologies. The quantitative aspect centered on identifying parameters for the recommendation system, while the applied research phase entailed utilizing the Scrum method for the development project after parameter.

Quantitative Research

At this stage, research will be carried out by distributing questionnaires with the aim of identifying the parameters that influence readers in choosing light novels to read. A questionnaire is a written statement consisting of a set of questions or written statements used to obtain information from respondents in the form of a report about a person or things they are familiar with. The questions are as follows:

1. How much do you consider the author's reputation when selecting a light novel?
2. How much do you rely on reviews and recommendations from others when choosing a light novel?
3. How much do you consider the genre when selecting a light novel to read?
4. How much do you consider the length of the light novel when selecting a light novel to read?
5. How much do you consider the popularity when selecting a light novel to read?

The analysis of this study will involve the use of percentages and frequencies, which can be calculated using the formula (1) below (Shilfani & Limbongan, 2022):

$$p = \frac{f}{n} \times 100 \dots\dots\dots (1)$$

P = Percentage of respondents
 f = frequency of respondents who voted
 n = total respondents

Applied Research

System Development

The light novel web system development method used in this study is Scrum framework. Scrum is an agile project development method that is used by teams to collaboratively develop projects in short cycles



Figure 1. Scrum Agile

The implementation of the Scrum method is divided into several stages:

1. Scrum Team

The following is the scrum team structure that has been prepared to carry out project development.

Table 1. Scrum Team

Role	Responsibility
Product Owner	1. Analyze project requirements 2. Create and compile the product backlog 3. Review project development results at each sprint
Scrum Master	1. Monitor and provide guidance on the implementation of Scrum to the team 2. Monitor the progress of the product backlog
Development Team	1. Carrying out the project development process 2. Testing project development results

2. Product backlog:

A prioritized list of tasks that need to be completed by the team during the project development phase. The list contains a brief description of all the features desired in the product, their sequence, estimated time, and their own value. The main features to be designed include:

Table 2. Product Backlog

Issue	User Story
Design Use Case Diagram & Entity Relationship Diagram	As the owner, I aim to establish a Use Case Diagram (UCD) and Entity-Relationship Diagram (ERD) as the fundamental framework for system development.
User Authentication	As the owner, I desire to implement basic authentication within the system: 1. Login 2. Register 3. Logout 4. View User Profile 5. Edit User Profile 6. Change Password
Light Novel Management	As an Admin, I want to have light novel management at the system, so I can: 1. See all list novels. 2. Add new novel. 3. Edit novel 4. Delete novel 5. See all list chapters of novel. 6. Add chapter 7. Edit chapter 8. Delete chapter
Light Novels Page & Chapter Page	As a user, I want to find the novel and choose which chapter to read.
Bookmark Page	As a user, I would like to bookmark light novels that I find interesting, enabling me to merely open my bookmarks whenever using the system again to continue reading the desired novels without having to search

	through the novel list page anew.
Light Novel Recommendation	As a user, I desire a conversational recommendation system that can suggest light novels to me.

3. Sprint planning:

During sprint planning, the team collaborated to define what could be delivered and how it would be achieved. The product backlog was reviewed and refined for clarity, and the team decided on the sprint goal and how to achieve it. The event also included breaking down the product backlog into smaller tasks to be delivered during the sprint.

At this point, the author sets one sprint for 2 weeks, and the project design will span over 5 sprints. Here is a summary of the sprint backlog that has been worked on during these 5 sprints.

Table 3. Sprint Planning

Sprint Backlog	Jan				Feb				Mar	
	1	2	3	4	1	2	3	4	1	2
Sprint 1										
Designing UCD & ERD	█									
Designing Mindmap		█								
Sprint 2										
Authentication			█							
Light Novel Management			█	█						
Chapter Management				█						
Sprint 3										
Home Page					█					
Light Novels List Page					█					
Light Novel Detail Page						█				
Chapter Page							█			
Sprint 4										
Edit Profile							█			
Change Password								█		
Bookmark Novel									█	
Sprint 5										
Chatbot (CRS)									█	█

4. Daily scrum:

A brief meeting where team members report on their progress, discuss plans, and identify obstacles to ensure they are on track to meet the sprint goal.

5. Sprint review:

In this stage, a review of the completed or remaining tasks is conducted with the supervising lecturer after each sprint. Blackbox testing is also performed during this stage to test the project. After the review, the product backlog is revised, and the priority of the tasks to be completed in the next sprint is determined.

6. Sprint retrospective:

In this stage, the author will ask for the supervising lecturer's assistance in checking what has been achieved in one sprint. The purpose of this stage is to get feedback and suggestions from the supervising lecturer and to evaluate oneself in order to develop a work plan for the next sprint.

7. Increment:

The result of completing all the tasks in the product backlog.

Light Novel Recommendation Chatbot Development

The book recommendation chatbot development method used in this study is RAG (Retrieval Augmented Generation) vector database. This method allows LLMs to dynamically provide context and reduce the need for manual updates, making the chatbot more efficient and effective in providing accurate information. The LLM model used in this research is the model provided by OpenAI, GPT-3.5 (Mansurova et al., 2023).

The development stage involves the following steps:

1. Data Collection

The researcher will aggregate light novel data from diverse sources using web scraping techniques. The acquired data will be stored in an unstructured format, such as a PDF, containing information from light novels based on parameters obtained through a questionnaire.

2. Data Preprocessing

The collected book data is processed and divided into chunks to create embeddings and store

embeddings to a vector database using LangChain, a framework built around Large Language Models.

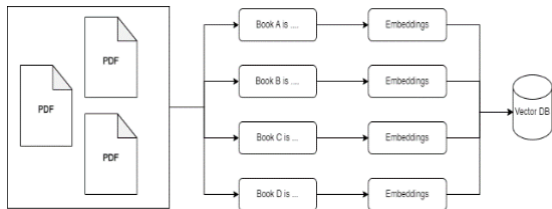


Figure 2. Data Processing and Embedding Creation

3. Integrating with RAG

At this stage, the LLM model is integrated with the RAG vector database to enable the chatbot to search and filter relevant information.

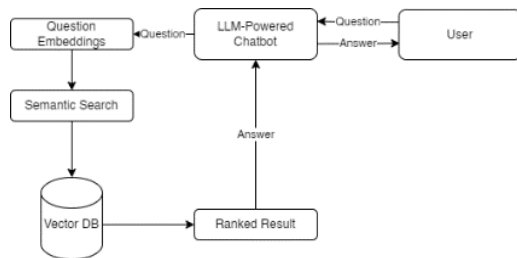


Figure 3. Integration

4. Building the Chatbot with LLM

After integrating the LLM model with the RAG vector database, the next step involved building the chatbot using LangChain's tools and integrations for web-based deployment. This included using LLM to generate responses based on the retrieved information. The interface is implemented in Next.js and uses the GPT-3.5 model from the OpenAI API (Huang et al., 2023; Mansurova et al., 2023; Situmeang et al., 2023).

5. Testing

At this stage, the model is tested to check whether the resulting book recommendations match expectations. Black-box testing, a method of software testing that examines the functionality of an application without peering into its internal structures or workings, can be used for this purpose (Wijaya et al., 2020).

In our research, we employed a questionnaire to determine which parameters influence and can be used for light novel recommendations. The questionnaire was designed to gather data on readers' preferences and reading habits, as well as their opinions on various aspects of light novels. The results of the questionnaire were analyzed to identify the most significant parameters that influence readers' decisions to read a light novel.

The questionnaire was distributed to a diverse group of 100 readers, including both casual and avid readers, to ensure a representative sample. The results showed that several parameters significantly influenced readers' decisions to read a light novel. Results can be seen in the table below.

Table 4. Questionnaire Result

Parameter	Percentage	Reason/Opinion
Author	33%	Most respondents prioritize quality and content over the fame of the author when it comes to light novels. They believe that lesser-known authors can produce excellent works that deserve attention.
Genre	98%	Most respondents believe that the genre plays a crucial role in helping them discover light novels that align with their preferences.
Length	18%	Most respondents prioritize quality over the length of light novels. However, some find excessively long novels less engaging and lose interest in reading them.
Popularity	93%	Most respondents believe that light novels with high ratings are indicative of good quality.

HASIL DAN PEMBAHASAN
Quantitative Research

		These ratings reflect the collective assessment of the public, making them a reliable measure of a novel's worth.
Synopsis	98%	Most respondents consider the synopsis to be crucial. It offers a glimpse into the story and significantly impacts the reader's decision to dive into the novel.

Considering the findings, the author has opted to construct a dataset for the chatbot using key parameters such as genre, popularity, and synopsis. This dataset will serve as the foundation for creating an effective conversational recommender system.

First Sprint

During the initial sprint planning, the author's primary objective was to finalize the design of the Product Backlog, specifically focusing on the creation of the Use Case Diagram (UCD) and the Entity Relationship Diagram (ERD). Subsequently, the outcomes of the first sprint review are as follows:

1. Use Case Diagram

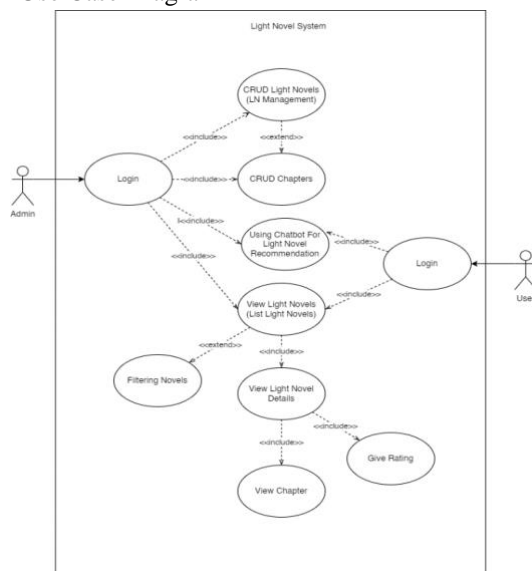


Figure 4. Use Case Diagram

According to Figure 4, administrators possess comprehensive system access, including the ability to

perform CRUD operations on Light Novels and Chapters, as well as the capability to view Novels and Chapters. Additionally, administrators can utilize the Chatbot for novel recommendations. On the other hand, users have access to view Novels, view Chapters, and use the Chatbot for novel recommendations.

2. Entity Relationship Diagram

Figure 5 shows the model used to design the database on the light novel website system.



Figure 5. Entity Relationship Diagram

3. Sprint Review

Within the confines of this iterative development cycle, the outcomes are systematically exhibited to the product proprietor and the collective team. Subsequently, a consensus is reached to incorporate these outcomes into the forthcoming developmental endeavor.

4. Sprint Retrospective

Table 5. First Sprint Retrospective Result

What went well?	What went wrong?	How to improve?
All tasks are completed on time	-	-

Second Sprint

During the second sprint planning, the team aimed to achieve two primary objectives: Authentication product backlog and light novel management admin. Subsequently, the outcomes of the second sprint review are as follows:

1. Login Page

This web page serves as an interface for user or administrator authentication.

Figure 6. Login Page

2. Register Page

This web page facilitates user account registration.

Figure 7. Register Page

3. Light Novel Management

This web page provides administrative access to novel-related functionalities, including novel registration tracking, addition of new novels, and modification or removal of existing novel records.

Figure 8. Light Novel Management Page

4. Chapter Management

This web page provides administrative access to novel-related functionalities, including tracking the number of chapters, adding new chapters, and modifying or removing existing chapter records.

Figure 9. Chapter Management Page

5. Sprint Review

Within this sprint, the generated backlog outcomes are systematically demonstrated to the product owner and end-users, with the resultant output deemed suitable and acknowledged.

In addition, an empirical method of system testing, known as black box testing, was executed. The outcomes of this testing methodology are documented in the subsequent tabulation.

Table 6. Second Sprint Blackbox Testing Result

Testing	Expected Result	Result
User Login	Users can access the login page and log in	OK
Admin Login	Admin can access the login page and log in	OK
Register	Users can access the register page and create account	OK
Logout	User can logout	OK
Light Novel Management	Admin can add, edit and delete light novels.	OK
Chapter Management	Admin can add, edit and delete chapters	OK

6. Sprint Retrospective

Table 7. Second Sprint Retrospective Result

What went well?	What went wrong?	How to improve?
All tasks are completed on time	The coding results are still not	Improve the code to make it clearer and more structured

	neatly structured	
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Third Sprint

The third sprint planning aims to finalize the development of the product backlog light novel list page, implement the filtering feature, and enhance the light novel detail page. Below are the outcomes of the review conducted during the third sprint.

1. Home Page

This web page serves as the initial landing page for users upon opening the website.

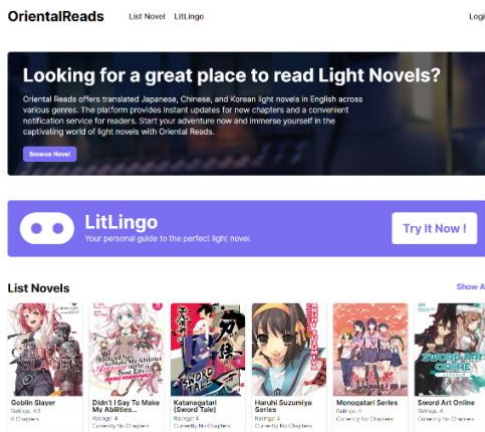


Figure 10. Home Page

2. Light Novel List Page

This web page serves as a comprehensive repository of novels, complete with an array of user-friendly features. Users can explore a curated list of novels and utilize powerful search and filtering functionalities to enhance their browsing experience.

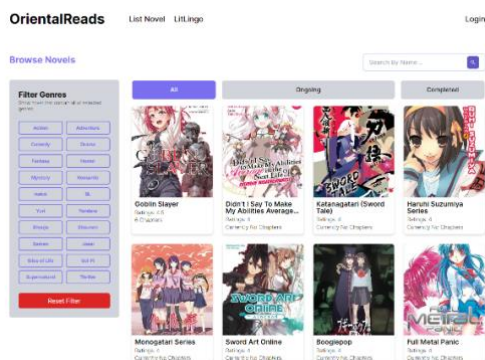


Figure 11. Light Novel List Page

3. Light Novel Detail Page

This web page serves as a repository for detailed information about a selected light novel. Additionally, it includes functionalities for bookmarking and rating light novels.

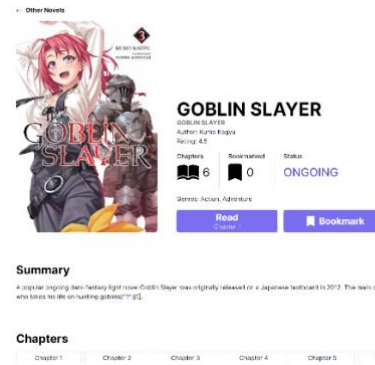


Figure 12. Light Novel Detail Page

4. Chapter Page

This web page serves as a repository for the textual content of specifically chosen chapters within a light novel.

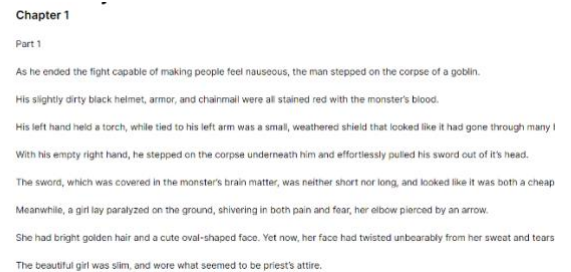


Figure 13. Chapter Page

5. Sprint Review

Within this sprint, the generated backlog outcomes are meticulously demonstrated to the product proprietor and end-users, with the resultant output deemed suitable and acknowledged. Supplementary feedback, which may pertain to the refinement of coding practices, is also obtained and earmarked for future rectification and enhancement.

Furthermore, the outcomes of the empirical black box testing methodology are documented and can be observed in the subsequent tabular representation.

Table 8. Third Sprint Blackbox Testing Result

Testing	Expected Result	Result
Home Page	Users can view and access the homepage as the main display when opening the website	OK
Light Novel List Page	Users can view the light novel list and search using the search and filter features	OK
Light Novel Detail Page	Users can view the details of a selected light novel and see a list of existing chapters	OK
Chapter Page	Users can view the content of the selected chapter	OK

6. Sprint Retrospective

Table 9. Third Sprint Retrospective Result

What went well?	What went wrong?	How to improve?
All tasks are completed on time	The coding results are still not neatly structured	Improve the code to make it clearer and more structured

Fourth Sprint

The fourth sprint planning aims to finalize the development of the product backlog pages for user profile editing, password modification, and bookmarked novel management. Below are the outcomes of the review conducted during the fourth sprint.

1. Edit Profile Page

This web page provides users with a form to update and modify their profile information.



Figure 14. Edit Profile Page

2. Change Password

This web page provides users with a form to modify their account password.

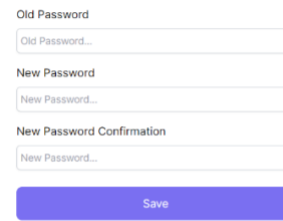


Figure 15. Change Password Page

3. Bookmarked Novel Page

This web page compiles a catalog of novels that users have marked as bookmarks.

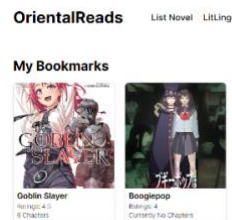


Figure 16. Bookmarked Novel Page

4. Sprint Review

During this sprint, the backlog outcomes that have been produced are methodically showcased to both the product owner and end-users. The resulting output is considered appropriate and accepted. Furthermore, an empirical system testing approach, specifically black box testing, was implemented. The results of this testing methodology have been meticulously recorded in the subsequent tabular representation.

Table 10. Fourth Sprint Blackbox Testing Result

Testing	Expected Result	Result
Edit Profile	Users can access the edit profile page and change or update their profile.	OK
Change Password	Users can update or change their password	OK

Bookmarked Novel Page	Users can see a list of bookmarked light novels	OK
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5. Sprint Retrospective

Table 11. Fourth Sprint Retrospective Result

What went well?	What went wrong?	How to improve?
All tasks are completed on time	The coding results are still not neatly structured	Improve the code to make it clearer and more structured

Fifth Sprint

The fifth sprint planning aims to finalize the chatbot product backlog related to the recommendation system. Below are the outcomes of the review conducted during the fifth sprint.

1. Recommendation System Design Result

Chatbot design for recommendation systems using the RAG method. The recommendation system flow design is in Figure 21 below.

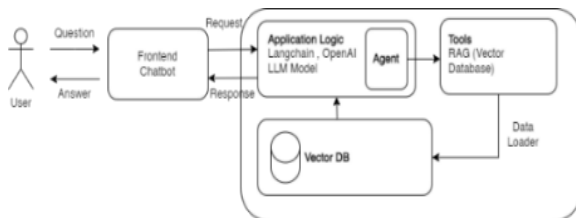


Figure 17. Recommendation System Design Result

First, users will ask questions or ask for recommendations from the chatbot. From user requests, the chatbot recommendation system that is built will filter and embeddings in the vector database to search for related ones and then return them as a response to the user.

2. Pinecone Vector Database

The dataset used in the study is collected based on the results of a questionnaire. The dataset used comes from web scrapping results from various sources which were initially saved in the form of a .txt file.

1. KonoSuba: God's Blessing on This Wonderful World! (Light Novel)
 Game loving shut-in Kazuma Sato's life as a young schoolboy in Japan abruptly comes to an early end...or at least it was supposed to. When he opens his eyes, though, he sees a beautiful goddess that offers him a once in an after-lifetime chance to be reborn in a parallel world. The catch is that the world is violent and threatened by a growing evil! Fortunately, he can choose any one thing to bring with him. So he chooses the goddess, Aqual And so his adventure with his gorgeous companion begins--if he could just get enough money and food to survive, keep his goddess out of trouble, and avoid grabbing the attention of the Demon King's army!
 Genre : Action, Adventure, Comedy, Fantasy, Harem, Light Novels, Romance, Game Elements, gods, Guilds, Isekai, Magic, NEET, Person in a Strange World, Reincarnation, Supernatural, Adapted to Anime.
 Vol: 17; Ch: 127
 Year : 2013 - 2020
 Rate : 4.2/5

2. Ecstas Online (Light Novel)
 Low in social standing in the school castle Doumeguri Kakeru, reincarnate into the strongest Demon Lord Hellshaft dominating the Virtual-Reality Game Exodia Exodus. Furthermore, he obtained the "Forbidden Power" (Adult Mode). However, the players who appeared was none other than the girl he admires Asagiri Ririko who was also his classmate. Asagiri and the others believe that if they are to defeat the Demon Lord Hellshaft, they can return to their former world, but in fact, everyone's lives would

Figure 18. Light Novel Raw Data

The .txt file will be processed into numbers for embeddings and divided into chunks to be stored in a vector database. The database used at this stage is the pinecone vector database.

```
const text = fs.readFileSync(process.cwd() + "/public/testing.txt", "utf8");
const textSplitter = new RecursiveCharacterTextSplitter({
  chunkSize: 1000,
});
const docs = await textSplitter.createDocuments([text]);
// create vector store
const vectorStore = await PineconeStore.fromExistingIndex(
  new OpenAIEmbeddings({
    modelName: "text-embedding-3-small",
  }),
  {
    pineconeIndex: pineconeIndex,
    textKey: "text",
  }
);
await PineconeStore.fromDocuments(
  docs,
  new OpenAIEmbeddings({
    modelName: "text-embedding-3-small",
  }),
  {
    pineconeIndex,
  }
);
```

Figure 19. Vector Data Preparation Code Snippet

```
Document {
  pageContent: 'Vol: 8; Ch: 57\r\n' +
  'Year: 2015 - 2018\r\n' +
  'Rate: 4.2/5\r\n' +
  '\r\n' +
  '34. Ascendance of a Bookworm: Royal Academy Stories - First  

  After the graduation ceremony ends and the library falls q  

  he many special memories she has made along the way, this new sid  

  elves! In this particular volume, there are stories from the first  

  her Ehrenfest students, and even dormitory supervisors. Events pr  

  n this recollective volume of your favorite biblio-fantasy, compr  

  \r\n' +
  'Genre: Comedy, Drama, Fantasy, Light Novels, Magic, Nobilit  

  Vol: 1; Ch: 18\r\n' +
  'Year: 2018' +
  'metadata: { loc: [Object] }
  },
  Document {
    pageContent: 'Genre: Comedy, Drama, Fantasy, Light Novels, Ma  

    Vol: 1; Ch: 18\r\n' +
    'Year: 2018\r\n' +
    'Rate: 4.2/5\r\n' +
    '\r\n' +
    '35. Toradora! (Light Novel)\r\n' +
    'Ryuji Takasu has an eventful life: his classmates think h  

    and he's just had an unfortunate encounter with 'palm-sized tail  

    ers, the two clash like night and day! that is, except for the fa  

    abounding, the duo must now work together to play matchmaker fo  

    'Genre: Comedy, Drama, Light Novels, Romance, coming of Age  

    'Vol: 10; Ch: 60\r\n' +
    'Year: 2006 - 2009\r\n' +
    'Rate: 4.2/5' +
    'metadata: { loc: [Object] }
  },
```

Figure 20. Presentation of The Processed Data.

-0.0033588859,	0.0068830503,	-0.0020966379,	-0.023117665,	0.025591511,
-0.020654483,	-0.020174641,	-0.00065644894,	0.019033687,	-0.0036361273,
-0.07250928,	-0.021230292,	-0.01611199,	0.03911236,	0.003604138,
0.020686472,	-0.053614218,	0.03375947,	-0.01958817,	0.05178016,
0.033951405,	0.034463238,	0.009122307,	0.026935067,	-0.009052997,
-0.016325252,	-0.03169082,	0.00530101,	0.05365687,	-0.00012037674,
0.00446252,	-0.009970027,	0.012273262,	-0.022883076,	-0.019023024,
-0.026551194,	0.043932095,	0.01584541,	0.052206684,	-0.021550186,
0.002509504,	-0.027532929,	0.07515374,	-0.01380742,	-0.014768435,
0.04254589,	-0.007227612,	-0.002588475,	0.014576498,	-0.045765152,
-0.051225677,	-0.012432089,	0.0075388377,	-0.037022386,	-0.018937718,
-0.015877401,	-0.019940054,	-0.0037107693,	0.013211618,	-0.018415226,
0.0055341646,	-0.015834749,	0.02817199,	0.032714482,	-0.032245304,
0.014917719,	0.021166313,	-0.037640847,	-0.057836816,	0.0036547878,
-0.019193634,	-0.031733476,	-0.010812414,	0.03056053,	0.0043345625,
0.021614164,	0.031456232,	-0.033162333,	-0.0031482892,	-0.010364562,
-0.03495374,	0.019118993,	-0.02503703,	0.025186313,	0.02320297,
0.004203939,	-0.038046047,	0.048922442,	-0.05856191,	0.034527216,
0.007288276,	-0.005062321,	-0.00803077,	0.0037854111,	0.027596181,

Figure 21. Transformation of Data into Vector Format.

3. Chatbot Integration

At this juncture, the chatbot is web-based and seamlessly integrated with LLM (Language Model) and vector databases. The designed chatbot interface is visible below.

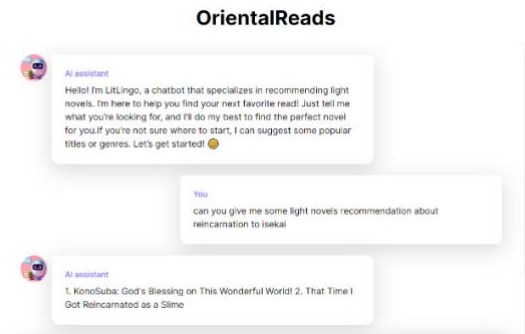


Figure 22. Chatbot Interface

The developed chatbot has been seamlessly integrated with LLM and vector database, enabling it to generate personalized recommendations based on user queries. The recommendation outcomes are presented below.

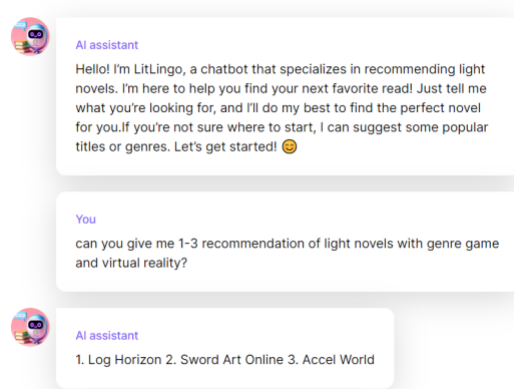


Figure 23. Recommendation Result

In the current phase of the process, recommendations are generated by leveraging semantic search outcomes. These outcomes are subsequently organized in a vectorial hierarchy, utilizing vector data procured from the Pinecone database. The recommendation output comprises vector data that exhibits the maximum value or score, aligning with the user's query. This methodology ensures the provision of the most relevant and high-quality recommendations.

ID	VALUES
1	70fae9b2-a134... -0.00941766705, 0.0551656596, -0.0410803109, -0.0322857834, 0.0
SCORE	0.5520
METADATA	loc.lines.from: 624 loc.lines.to: 635 text: "Vol: 10 Year: 2010 - 2011 Rate: 4.1/5 Vols:83. Log Horizon [Light Novel] Thirty II
2	38539ba4-0d... -0.00939125102, 0.055430714, -0.0413967296, -0.032111261, 0.0231
SCORE	0.5518
METADATA	loc.lines.from: 624 loc.lines.to: 635 text: "Vol: 10 Year: 2010 - 2011 Rate: 4.1/5 Vols:83. Log Horizon [Light Novel] Thirty II
3	780b2fad-d37... 0.0122377342, 0.0425958186, -0.045856066, -0.00101070572, 0.027
SCORE	0.5447
METADATA	loc.lines.from: 770

Figure 24. Vector Ranking Result

Figure 22 delineates the ranking procedure of the recommendation outcomes depicted in Figure 21. The recommendations proffered possess the highest scores, specifically 0.5520, 0.5518, and 0.5447, which closely align with the user's query.

In the depicted scenario, the conversational recommendation system offers personalized suggestions to users based on their specific requests and individual preferences. Furthermore, users have the capability to directly inquire about additional information or seek follow-up recommendations in response to the system's initial answers.

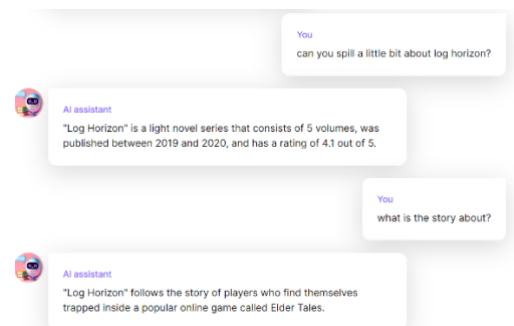


Figure 25. Follow-up Questions

```

{
  "query": "what is the story about?",
  "history": [
    {
      "role": "assistant",
      "content": "Hello! I'm LitLingo, a chatbot that specializes in recommending light novels. I'm here to help you find your next favorite read! Just tell me what you're looking for, and I'll do my best to find the perfect novel for you. If you're not sure where to start, I can suggest some popular titles or genres. Let's get started! 😊"
    },
    {
      "role": "user",
      "content": "can you give me 1-3 recommendation of light novels with genre game and virtual reality?"
    },
    {
      "role": "assistant",
      "content": "1. Log Horizon 2. Sword Art Online 3. Accel World"
    },
    {
      "role": "user",
      "content": "can you spill a little bit about log horizon?"
    },
    {
      "role": "assistant",
      "content": "\"Log Horizon\" is a light novel series that consists of 5 volumes, was published between 2019 and 2020, and has a rating of 4.1 out of 5."
    },
    {
      "role": "user",
      "content": "what is the story about?"
    }
  ]
}
    
```

Figure 26. Follow-up Chat History Payload

In cases where user inquiries fall outside the domain of the chatbot's expertise, the system will appropriately respond with 'I don't know'.

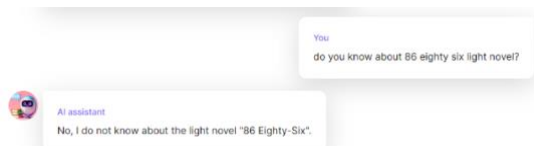


Figure 27. Chatbot Response When Encountering Unknown Queries

This implementation was constructed utilizing a promptTemplate, which facilitates the creation of a more specialized model, specifically tailored for the objective of book recommendations.

```
promptTemplate:
    "You are chatbot named Littlingo, the Light Novel Recommender System. If user is asking something outside of novel, dont answer them and just say dont know. The query: '{message}' "
```

Figure 28. Prompt Template Implementation

4. Sprint Review

During this sprint, the LLM-based chatbot was seamlessly integrated with the vector database and successfully deployed on the designed light novel website. Additional feedback from the sprint review includes addressing code inefficiencies and augmenting the chatbot’s knowledge by incorporating additional light novel data.

The outcomes of the empirical black box testing are documented and can be observed in the subsequent tabular representation.

Table 12. Fifth Sprint Blackbox Testing Result

Testing	Expected Result	Result
Chatbot Recommendation	Users can chat with the chatbot and get appropriate recommendations.	OK

CONCLUSION

In summary, this research aimed to enhance website development by integrating it with large language model (LLM) technology. The outcome of this study is a web-based online light novel application, developed using the Scrum methodology, and featuring an LLM-based chatbot conversational recommender system built using the RAG method. Through this system, users can access and read light novels online, while also utilizing the chatbot to request novel recommendations.

The research findings demonstrate the successful integration of LLM technology and vector databases into a web-based light novel application. The Scrum development approach facilitates the creation of

efficient systems, and RAG-based chatbots are seen as successful in producing recommendations that match user queries based on existing knowledge. Recommendation results are obtained from semantic search and from the ranking vector with the highest score.

Despite the achievements, certain limitations exist. For instance, the chatbot’s knowledge is constrained by its training data, and it may respond with ‘I don’t know’ when faced with queries beyond its scope. Additionally, the system’s performance may vary based on user interactions and novel availability.

To advance this field, future research efforts could conduct research that combines fine-tuning and RAG (Retrieval-Augmented Generation) techniques in producing chatbots with better performance. Apart from that, research can also be carried out on developing a recommendation chatbot that combines internet live search features which have the potential to prevent problems with limited data.

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