VIETNAM DATATHON 2023

CHATBOT RECOMMEND FURNITURE PRODUCTS

Team: COINCARD

Members: Nguyen Tran Huu Cuong

Luong Nguyen Dinh

Nguyen Bach Nhut Tien

Ho Dinh Trieu

Lai The Trung

HCMC, November 2023

Contents

I. INTRODUCTION

Furniture shopping is one of the biggest purchase decisions households make. However, finding the perfect furniture that fits one's home interior, functionality needs, budget and preferences can be an overwhelming and time-consuming process. Customers are often faced with navigating through vast product catalogs online or visiting multiple brick-and-mortar stores to view options and compare different features. This complex in-person research and purchasing journey leaves much room for improvements in the digital era.

Chatbots have emerged as a promising technological solution to enhance the furniture shopping experience and make it more convenient and personalized for customers. By facilitating natural language conversations, chatbots can guide users throughout their decision making and fulfillment process right from their mobile devices or computers. With the use of artificial intelligence techniques like named entity recognition (NER), chatbots understand customers' needs, wants and constraints simply from their conversational inputs. For instance, a conversational AI can effectively identify furniture types, styles, materials, price ranges, colors and other attributes mentioned by customers. Leveraging such contextual understanding, chatbots can suggest suitable furniture recommendations tailored to the user's specific requirements.

In addition, chatbots serve as 24/7 virtual assistants that can answer various purchase and post-purchase related queries from customers. Examples include providing product specs and dimensions, address delivery/installation concerns, respond to queries regarding payment or return policies. This offers endless flexibility to customers and expands traditional store hours. Chatbots also obviate the need for customers to sift through cluttered websites or deal with unhelpful customer service representatives, improving the overall shopping experience.

This proposal aims to develop a named entity recognition powered conversational agent to streamline the furniture selection and research process for users. The key objectives are to understand customers' needs from natural language conversations, offer personalized item suggestions accordingly and serve as a virtual guide for all associated inquiries. The subsequent sections will discuss the proposed system architecture, key features, technologies used, implementation timeline and estimated budget for this chatbot recommendation project.

II. PROBLEM STATEMENTS

The contemporary online furniture shopping experience is marred by inefficiencies and a lack of personalized guidance, hindering users from discovering products that truly align with their preferences and requirements. Customers often face the daunting task of sifting through vast product catalogs, struggling to articulate their specific needs within the confines of traditional search interfaces. The absence of an intelligent recommendation system exacerbates this issue, resulting in a suboptimal user journey characterized by frustration and reduced satisfaction.

In the contemporary landscape, the process of purchasing items online is fraught with numerous inconveniences:

- *Tedious Search Process*: Users are burdened with the laborious task of manually browsing through extensive furniture collections, leading to fatigue and potential abandonment of the shopping process.
- *Ineffective Query Handling*: Existing search mechanisms lack the ability to interpret nuanced user queries regarding style preferences, room dimensions, and specific furniture features, resulting in generic and often irrelevant results.

- *Limited Personalization*: The absence of a personalized touch in the recommendation process diminishes user engagement and fails to capitalize on opportunities for upselling or cross-selling.

While some brands in the online furniture market offer basic search functionalities, a comprehensive and intelligent recommendation system powered by advanced NLP, specifically Name Entity Recognition (NER), remains largely untapped. Brand owners predominantly rely on conventional search algorithms that fall short in understanding the subtleties of user intent and preference.

Our project seeks to position itself as an industry pioneer by leveraging cutting-edge NLP technology to enhance the recommendation process. By addressing the current gaps in personalization and query interpretation, we aim to surpass existing competitors and establish our solution as the go-to platform for a seamless and tailored online furniture shopping experience.

III. SOLUTION OVERVIEW

Our proposed solution is a state-of-the-art chatbot recommendation system for online furniture shopping, underpinned by advanced Natural Language Processing (NLP) techniques, with a specific focus on Name Entity Recognition (NER). This innovative system aims to transform the user experience by addressing existing inefficiencies and pain points in the furniture discovery process.

1. Intelligent Recommendation Engine:

At the core of our solution lies a robust recommendation engine empowered by NER. This engine employs machine learning algorithms to analyze and interpret user queries, extracting key entities such as furniture preferences, style choices, and spatial constraints. By understanding the nuances of user input, the chatbot can provide highly personalized and contextually relevant furniture recommendations, surpassing the limitations of traditional search methods.

2. Seamless User Interaction:

Our chatbot is designed to engage users in natural language conversations, eliminating the need for rigid and structured queries. Through a user-friendly interface, customers can articulate their requirements, seek advice, and receive tailored recommendations effortlessly. This not only simplifies the user journey but also encourages more dynamic and meaningful interactions, fostering a sense of personal connection with the platform.

3. Context-Aware Query Interpretation:

The incorporation of NER ensures that the chatbot can grasp the context and intent behind user queries. Whether users inquire about specific design elements, room dimensions, or seek recommendations for complementary pieces, our solution excels in understanding and responding to the intricacies of each request. This context-aware approach significantly enhances the relevance and accuracy of the recommendations provided.

4. Personalization and User Profiling:

Our solution goes beyond generic suggestions by creating individual user profiles based on preferences and interactions. As users engage with the chatbot over time, the system learns and adapts, refining its recommendations to align more closely with evolving tastes. This personalization not only enhances the overall user experience but also opens avenues for targeted marketing and upselling opportunities.

5. Continuous Learning and Improvement:

The chatbot is designed to continuously learn from user interactions, feedback, and emerging trends in the furniture market. This adaptive learning mechanism ensures that the recommendation engine evolves over time, staying ahead of changing user preferences and industry dynamics.

In summary, our solution revolutionizes the online furniture shopping experience by providing an intelligent, context-aware, and personalized recommendation system. Through the strategic integration of NER, we anticipate not only meeting but exceeding user expectations, establishing our platform as a trailblazer in the intersection of e-commerce and advanced NLP technologies.

IV. METHODOLOGIES

To achieve the objectives of transforming the furniture shopping experience through a personalized and intelligent chatbot solution, we will adopt the following systematic methodological approaches:

1. Data Collection and Pre-Processing:

In the provided dataset, consisting of 369 samples showcasing various types of IKEA furniture, each entry comprises 13 columns containing information such as name, ID, dimensions, short description, etc.

Upon delving into the dataset, it becomes evident that some entries contain missing values in the dimensions of depth, height, and width. Complicating matters, the short description column also contains dimension information, yet the specific dimension (e.g., depth, height, width) remains unclear.

Another challenge arises from the product links. Although each entry contains a link, only the first link provides access to the product. Therefore, an approach must be devised to locate the product by name and retrieve the accurate link, facilitating the resolution of missing data in the three dimension columns.

For the training data, a Generative model is employed to generate prompts resembling customer queries. These prompts leverage the short description field within the dataset, aiming to assist customers in identifying their preferred furniture. This process involves training the model to understand the nuanced language in short descriptions, thus enhancing its ability to respond effectively to customer queries.

2. Machine Learning Model Development:

The heart of our project lies in the development of advanced machine learning models that harness the power of state-of-the-art neural network architectures. This section outlines the methodologies we will employ to enhance natural language understanding, build effective classification and recommendation models, and ensure optimal performance through thorough evaluation.

2.1. Natural Language Understanding with Sequential Models:

- Long Short Term Memory (LSTM):

- Implement LSTM networks to capture sequential dependencies within the textual features of IKEA products, facilitating a nuanced understanding of their descriptions and names.

- Leverage the memory retention capabilities of LSTMs to discern complex relationships and contextual nuances.

- Bidirectional LSTM (BiLSTM):

- Extend the LSTM approach by incorporating bidirectional information flow, enabling the model to consider both past and future context during text processing.
- Enhance the ability to understand diverse language structures and provide more accurate representations of product information.

2.2. Classification and Recommendation Models:

- Term Frequency-Inverse Document Frequency (TF-IDF):

- Employ TF-IDF vectorization to extract crucial contextual features from textual data, emphasizing the significance of specific terms within IKEA product descriptions.
- Utilize TF-IDF representations for developing classification models to categorize products based on textual features.

- Count Vectorization:

- Apply Count Vectorization to convert textual data into numerical representations, capturing term frequencies within product descriptions.
- Leverage count vectors to build recommendation models, enabling personalized product suggestions based on similar textual characteristics.

2.3. Transfer Learning Techniques:

- BERT (Bidirectional Encoder Representations from Transformers):

- Explore transfer learning using BERT for intent detection and query understanding, capitalizing on its ability to comprehend context and nuances.
- Fine-tune pre-trained BERT models on the IKEA dataset to enhance natural language processing capabilities.

- GPT (Generative Pre-trained Transformer):

- Investigate the use of GPT models for generating contextualized responses and understanding user preferences during interactions.
- Fine-tune pre-trained GPT models to elevate the chatbot's conversational abilities and provide tailored recommendations.

2.4. Hyperparameter Tuning and Optimization:

- Conduct a meticulous exploration of hyperparameters for each model architecture.

- Utilize grid search and randomized search techniques to find optimal combinations that maximize accuracy, efficiency, and user-centric performance.

2.5. Evaluation on Test Datasets:

- Rigorously evaluate each model on dedicated test datasets to ensure robust generalization and performance in real-world scenarios.

- Employ a range of metrics, including accuracy, precision, recall, and F1 score, to comprehensively assess classification and recommendation models.

2.6. Model Selection for Deployment:

- Based on comprehensive performance evaluations, select the most effective models for deployment.

- Prioritize models that demonstrate superior accuracy and user-centric performance, ensuring a seamless and engaging experience for our users.

3. Chatbot Interface Design:

Interactive chatbot interfaces will be designed and developed using popular frontend frameworks to facilitate seamless human-computer conversations. natural language workflows and responses covering common scenarios will be created. Integration of multimedia features like images, videos will be enabled for enhanced user experience. All components will be made responsive for optimal experience across devices. Proper error handling, feedback mechanisms will also be implemented.

4. Knowledge Graph Development:

An ontology will be engineered to map entity relationships and build connections between products, users and their interactions with the system over time. A knowledge graph will be constructed powering the recommendation engine with contextual information instead of standalone data points. It will continually evolve on the basis of new data.

5. Testing and Validation:

Rigorous testing will be performed at unit, integration and system levels to validate workflows, responses against edge cases. A/B testing and multivariate experimentation will be carried out to analyze results from personalized recommendation and compare against standard baseline recommendations. Metrics like click-through rates will help refine the models.

6. Continuous Learning:

As the chatbot is deployed and used by customers, reinforcement learning techniques will be applied to analyze usage patterns and automatic retraining of models. New data from user interactions will regularly be incorporated to continuously improve recommendations based on emerging trends, ensuring the bot remains up-to-date.

V. CORE FUNCTIONALITY

1. User Interaction and Query Handling:

- Natural Language Processing (NLP): Enable the chatbot to understand and process user queries in natural language, allowing users to articulate their furniture preferences, style choices, and spatial constraints conversationally.

2. Name Entity Recognition (NER):

- Contextual Information Extraction: Implement NER to extract key entities from user input, including furniture types, design elements, dimensions, and other relevant details, facilitating a nuanced understanding of user intent.

3. Intelligent Recommendation Engine:

- Machine Learning Algorithms: Develop a recommendation engine that employs machine learning algorithms to analyze user preferences and historical interactions, generating personalized furniture recommendations.

- Context-Aware Recommendations: Ensure the recommendation engine considers the context of user queries, providing suggestions that align with the specific needs and preferences expressed during the conversation.

4. User Profiling and Personalization:

- User Profiles: Create individual user profiles to store preferences, purchase history, and interaction patterns, enabling the chatbot to offer increasingly personalized recommendations over time.

- Adaptive Learning: Implement continuous learning mechanisms to adapt the recommendation engine based on user feedback, ensuring a dynamic and evolving understanding of user preferences.

5. Seamless Integration with E-commerce Platform:

- API Integration: Seamlessly integrate the chatbot with the existing e-commerce platform, enabling users to seamlessly transition from recommendations to product exploration, comparison, and purchase.

- Real-time Inventory Updates: Ensure the chatbot has access to real-time inventory information, preventing recommendations for out-of-stock items and enhancing the overall user experience.

6. Multi-Platform Accessibility:

- Cross-Platform Compatibility: Design the chatbot to be accessible across various platforms, including web browsers, mobile applications, and messaging apps, ensuring a consistent and user-friendly experience regardless of the user's preferred channel.

7. User Feedback and Iterative Improvement:

- Feedback Mechanism: Implement a feedback loop to collect user input and preferences, allowing the system to adapt and improve recommendations based on real-time user insights.

- Iterative Development: Adopt an iterative development approach, incorporating user feedback and addressing system performance to continuously enhance the chatbot's functionality and user satisfaction.

8. Security and Privacy Measures:

- Data Encryption: Implement robust data encryption mechanisms to safeguard user information and maintain the privacy and security of user profiles.

- Compliance: Ensure compliance with data protection regulations and industry standards to build trust and confidence among users.

VI. TIMELINE AND ROADMAP

Week 1: Project Initiation and Planning

- Project Kickoff and Team Assembly
- Define project objectives, scope, and success criteria.
- Assemble project team and assign roles.
- Prioritize core functionalities for the Minimum Viable Product (MVP).
- Develop a brief project plan and timeline.

Week 2: Design and Technology Selection

- System Architecture and Design
- Design a streamlined architecture for the chatbot and recommendation engine.
- Identify key integration points with the existing e-commerce platform.
- Technology Stack Selection
- Evaluate and select the technology stack based on project requirements.
- Finalize decisions on NLP and NER libraries and tools.

Week 3: Development of MVP

- Core Functionality Development
- Begin development of the chatbot interface and user interaction components.
- Implement basic NLP and NER functionalities for query handling.
- Develop a simplified version of the recommendation engine.
- Iterative Development and Testing
- Conduct iterative development cycles, addressing critical issues.
- Perform initial testing for core functionalities.
- Gather internal feedback and make necessary adjustments.

Week 4: Deployment and Launch

- Beta Testing and UAT
- Deploy a beta version of the chatbot for internal testing.
- Conduct User Acceptance Testing (UAT) with a limited user group.
- Address identified issues and refine the system based on feedback.
- Full Deployment and Optimization
- Launch the chatbot on selected platforms for the entire user base.
- Monitor real-time performance and user interactions.
- Implement quick optimizations based on user feedback and system analytics.
- Regular Check-ins and Reporting
- Conduct brief daily check-ins to address any immediate concerns.
- Provide concise progress updates to stakeholders as needed.
- Documentation
- Maintain essential documentation for code and system architecture.
- Update documentation with each iteration and phase of the project.

Finally:

- Presentation

VII. CONCLUSION

In conclusion, our proposed project to develop an intelligent furniture recommendation chatbot, enriched with Name Entity Recognition (NER) capabilities, presents a groundbreaking solution to the prevalent challenges in the online furniture shopping landscape. As we navigate the digital era, user expectations for personalized, efficient, and engaging experiences are at an all-time high. This project, with its focus on leveraging advanced NLP technology, not only acknowledges these expectations but aims to redefine and elevate the entire furniture discovery process.

By addressing the pain points of tedious searches, ineffective query handling, and limited personalization, our solution is poised to revolutionize the way users interact with online furniture platforms. The integration of NER into our chatbot's architecture represents a significant leap forward, allowing for a more nuanced understanding of user preferences and

intent. This not only enhances the accuracy of recommendations but also establishes a foundation for a more meaningful and personalized connection between users and the platform.

Furthermore, as we position ourselves in the current competitive landscape, our commitment to innovation sets us apart from traditional approaches employed by existing players. While competitors rely on conventional search algorithms, we strive to lead the industry by harnessing the full potential of NLP, ensuring that our chatbot becomes synonymous with a sophisticated, user-centric, and efficient furniture shopping experience.

In essence, this project aligns with the evolving demands of the digital consumer, promising not just a functional chatbot but an intelligent companion in the furniture discovery journey. As we embark on this endeavor, we anticipate not only meeting the expectations of our users but surpassing them, ultimately reshaping the online furniture shopping landscape and setting new standards for personalized, efficient, and delightful user experiences.

REFERENCES

[1] Hsu, PF., Nguyen, T.(., Wang, CY. et al., "Chatbot commerce—How contextual factors affect Chatbot effectiveness," *Electron Markets,* p. 4, 2023.

[2] Nicolescu, Luminița, and Monica Teodora Tudorache, "Human-Computer Interaction in Customer Service: The Experience with AI Chatbots—A Systematic Literature Review," *Electronics 11,* 2022.

[3] M. V. Koroteev, "BERT: A Review of Applications in Natural Language Processing and Understanding," 2021.

[4] Ren, K., Li, H., Zeng, Y., Zhang, Y., "Named Entity Recognition with CRF Based on ALBERT: A Natural Language Processing Model," *Proceedings of 2022 10th China Conference on Command and Control. C2 2022. Lecture Notes in Electrical Engineering, vol 949. Springer, Singapore,* 2022.

[5] D. Theosaksomo and D. H. Widyantoro, "Conversational Recommender System Chatbot Based on Functional Requirement," *IEEE 13th International Conference on Telecommunication Systems, Services, and Applications (TSSA), Bali, Indonesia,* pp. 154-159, 2019.

[1] [2] [3] [4]