A STUDY OF SMART ENHANCEMENTS IN SPECIALIZED AI APPLICATIONS COMPARING INITIAL VERSIONS TO UPGRADED MODELS WITHIN SUSTAINABLE URBAN PLANNING INTEGRATION

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Abstract: This study examines the development of specialist urban planning chatbots, with a specific focus on the development process from Chatbot 1.0 to Chatbot 2.0. The paper offers a comprehensive examination of the chatbot concept and its use in urban planning. The study highlights the need of involving citizens, sharing information, and making decisions based on data. The report provides an analysis of Chatbot 1.0, including its development process, inputs from stakeholders, significant restrictions, and features influenced by the ChatGPT API. The feedback received from stakeholders indicates a resounding approval for the urban planning chatbot, as a significant majority of respondents reported satisfaction and acknowledged its significance. Nevertheless, several constraints have been observed, including the inability to remember past discussions, do specific tasks, interpret visuals, and comprehend geographic information. The study focuses further into the justification for creating Chatbot 2.0, emphasizing the requirement for a superior, adaptable, and economical solution. Key improvements in Chatbot 2.0 encompass the incorporation of the Hugging Chat API, the ability to conduct real-time web searches, and the utilization of reliable data from Urban Development Authorities (UDA) for training purposes. Moreover, the chatbot's functionality and user experience are enhanced with features such as 'Pro Planning Mode' and a 'user-centric graphical user interface'. This study provides a comprehensive overview of the creation and improvement of a specific chatbot for urban planning. It describes the evolution of the chatbot from its initial form to address its initial constraints.

Keywords: *Chatbot 1.0, Chatbot 2.0, Hugging Chat API, real-time web search, Pro Planning Mode*

1. Introduction

Urban planning increasingly integrates advanced technologies like NLP-based chatbots, which streamline communication, enhance citizen engagement, and support data-driven decision-making (Janssen et al., 2022; Jaung, 2023). While chatbots are widely recognized in customer service and virtual assistance, urban planning applications have unique challenges. A primary issue in current urban planning systems is the limited and often slow feedback loop between planners and communities, hindering prompt responses to citizen concerns and timely updates on planning developments. Additionally, public engagement tools are typically fragmented, limiting efficient and centralized access to information (Yigitcanlar et al., 2021). This research aims to investigate how NLP-powered chatbots can address these limitations by centralizing information, providing real-time feedback, and promoting inclusivity in planning processes (Dortheimer et al., 2023).

The focus is on enhancing data-driven urban development through NLP and AI technologies, emphasizing inclusivity and transparency in planning activities (Caragliu et al., 2011; Rudolf et al., 2010). Specifically, the objectives of this study are- 1) to assess the effectiveness of a Chatbot API in improving community engagement and transparency, and 2) to explore the potential of an updated, open-source chatbot, Chatbot 2.0, in comparison with its predecessor, Chatbot 1.0, in achieving these outcomes.

1.1 RELATED WORK- MOVING FROM CHATBOT 1.0 TO CHATBOT 2.0

Chatbot 1.0 initially implemented the ChatGPT API for interacting with Sri Lankan urban planning data but was limited by reliance on a static knowledge base and restricted functionality. These limitations highlighted the need for a more adaptive solution. Chatbot 2.0 addresses these gaps by incorporating the Hugging Chat API, an open-source platform offering real-time search capabilities and enhanced language model customizability, providing more dynamic, contextually accurate responses.

Further, Chatbot 2.0 leverages data directly from the Urban Development Authority (UDA) website, offering more reliable and context-specific insights into urban planning inquiries. The addition of a specialized 'Pro Planning Mode' in Chatbot 2.0 limits responses to official UDA data, ensuring the accuracy and relevance of information shared with users. These modifications underline the study's objective to create a more robust tool for supporting informed, efficient, and responsive urban planning through AI-driven chatbots.

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2. Literature review

The significance of AI chatbots in urban planning AI chatbots are a progressive advancement in the field of Planning Support Systems (PSS). PSS are computer programs that aid urban planners by granting them access to data, models, and analytical tools (Adamopoulou & Moussiades, 2020; Mehra, 2021). These chatbots enhance user engagement by emulating human dialogue, providing a user-friendly and effective method for addressing queries, exchanging information, and delivering recommendations (Larbi et al., 2022; Gupta, 2020). AI chatbots are now in the initial phases of implementation in urban planning, but they possess the capacity to completely transform conventional approaches (Caragliu et al., 2011). As artificial intelligence technology progresses, it is anticipated that the planning process will be greatly enhanced by the development of innovative and efficient chatbot applications (Lou et al., 2021). Integrating artificial intelligence (AI) into urban planning allows chatbots to provide several advantages. These include more efficiency and productivity (Gupta, 2020), better decision-making (Adam et al., 2020), and increased public engagement (Caldarini et al., 2022). AI chatbots simplify labor-intensive activities including data collecting, analysis, and visualization, enabling urban planners to prioritize strategic and creative elements (Ray, 2023). Additionally, they improve decision-making by providing valuable insights and recommendations, allowing planners to model various urban scenarios and evaluate the resulting consequences (Johari & Nohuddin, 2021). Furthermore, chatbots driven by artificial intelligence are highly efficient instruments for actively involving the public in the process of urban planning. They have the ability to provide information regarding future projects and collect feedback from citizens, guaranteeing that planning decisions include a wide range of perspectives from stakeholders (Luo et al., 2021). This integration not only simplifies the responsibilities of planners, but also promotes active participation from the public and facilitates well-informed decision-making (Engin et al., 2020).

Chatbots enhance public engagement by fostering interactive communication between planners and communities, thereby promoting transparency and inclusivity in decision-making (Othengrafen et al., 2025). Digital twins offer dynamic simulations of urban scenarios, enabling planners to assess potential outcomes and improve infrastructure resilience and design (Ghisleni, 2024). AI-driven tools, like Google's Tree Canopy Assessment, support environmental sustainability by identifying areas in need of increased vegetation to mitigate climate challenges. Additionally, AI helps optimize municipal operations, from analyzing air quality data to assessing road damage, and streamlines various planning phases through pattern recognition and statistical automation (Othengrafen et al., 2025; Graute, 2024). Despite these advancements, AI functions as an auxiliary tool, with planners retaining the responsibility of interpreting its outputs and integrating them within participatory processes that balance diverse interests and priorities (Graute, 2024). AI urbanism utilizes technology such as autonomous vehicles, robots, and city brains to enhance urban environments and infrastructures, while also contributing to the improvement of urban planning (Cugurullo et al., 2022). Urbanism of this nature distinguishes itself from smart urbanism by utilizing the autonomous capabilities of artificial intelligence to improve urban governance and planning (Caprotti et al., 2022). AI urbanism seeks to enhance the efficiency of urban management andimprove the overall quality of life in cities (Li et al., 2024). The Hugging Face Transformers library is a Python-based utility that facilitates the integration of Hugging Face language models into applications, without requiring an API key. The software framework accommodates multiple model architectures like BERT, Roberta, DistilBERT, XLNet, and T5. This allows for a wide range of activities such as text production, translation, and question answering (Wang et al., 2023). Meta AI's Llama-2-70b-chat-hf is a highly advanced language model that consists of 70 billion parameters. It has been trained on enormous datasets that encompass a wide range of topics and formats. Unveiled in August 2023, it outperforms existing chat models that are open-source in terms of reasoning, coding, and knowledge evaluation, similar to top closed-source models such as ChatGPT and PaLM. Llama-2-70b-chat-hf is highly proficient in producing inventive text patterns and may be effectively used in chatbots, customer support platforms, and instructional programs. HuggingChat v0.6.0 incorporates Google Search to obtain real-time information, improving the accuracy and comprehensiveness of responses (Springer et al., 2023). Flask is a nimble Python web framework utilized for crafting online applications and APIs. It depends on the Werkzeug toolbox and utilizes the Jinja2 template engine. Werkzeug is responsible for managing intricate web activities, such as handling requests and managing sessions. On the other hand, Jinja2 enables developers to generate dynamic HTML content, guaranteeing a distinct separation between presentation logic and code. Flask's minimalistic design enables flexibility, facilitating the incorporation of other libraries to provide functionalities such as database support and user authentication. The software's intuitive interface and ease of use have contributed to its widespread adoption by developers (Dortheimer et al., 2023).

ALTERNATE LLMS

1. **Code Llama Models-** Developed by Meta AI, the Code Llama family includes Code Llama, Code Llama - Python, and Code Llama - Instruct, available in 7B, 13B, 34B, and 70B parameters. These models excel in code generation tasks like completion, infilling, and handling long contexts, surpassing other public models in various benchmarks. They are built on Llama 2's architecture and are suitable for program synthesis, debugging, and documentation (Rozière et al., 2023).
2. **Falcon-180B-chat-** Developed by TIIUAE and launched in October 2023, this model features 180 billion parameters optimized for chat activities. Using the Transformer architecture, it demonstrates superior performance in reasoning, coding, and knowledge assessments. Falcon-180B-chat rivals proprietary models like ChatGPT and PaLM in effectiveness and safety (Schmid et al., 2023; Chauncey & McKenna, 2023; Gill & Kaur, 2023).

3. Methodology

3.1 SYSTEM DESIGN AND ARCHITECTURE

Data Collection and Preparation

Data for both Chatbot 1.0 and Chatbot 2.0 was collected from a range of reliable sources, including the Sri Lankan Urban Development Authority's (UDA) official publications, development plans, and other authoritative documents. This data selection aimed to ensure that chatbot responses would remain accurate and contextually relevant to urban planning needs.

User Feedback Analysis

To assess user satisfaction and the perceived effectiveness of **Chatbot 1.0** in urban planning, feedback was collected from 91 participants. The feedback was analyzed using descriptive statistics, focusing on key satisfaction and relevance metrics for the chatbot. User satisfaction was gauged using a 5-point Likert scale (1 = Very Dissatisfied to 5 = Very Satisfied), where participants rated their experience on three main dimensions

1. **Desire for Chatbot** – Participants indicated whether they would like to use a chatbot for urban planning support.
2. **Appropriateness for Urban Planning** – Users rated how suitable they found the chatbot's responses and features for urban planning applications.
3. **Relevance to Urban Planning** – This rating assessed the chatbot's perceived importance in addressing urban planning inquiries effectively.

Key findings from the feedback analysis included

1. **Desire for Chatbot-** 88% of respondents expressed a desire to use the chatbot for urban planning purposes, rating it 4 or 5.
2. **Appropriateness for Urban Planning-** 91.2% rated the chatbot as appropriate, scoring it in the 4–5 range.
3. **Relevance to Urban Planning-** 64.8% of participants considered the chatbot highly relevant to urban planning tasks, assigning ratings of 4 and 5.

Strategic approach to development

The development method for Chatbot 2.0 entailed a thorough strategy to increase their Lang-Chain model, utilizing both quantitative measures and qualitative observations to refine the model. The emphasis was placed on the promptness of response, precision, and user input. Users appreciated the educational value, conversational interface, and accuracy of the chatbot in delivering planning information. Recommendations for enhancement involved broadening its range and augmenting engagement. The main objective was to enhance the system's understanding of context and semantics by employing search engine techniques to discover pertinent resources. The team's objective was to develop a user-friendly interface that accommodated users with different degrees of technical expertise. They conducted thorough user testing to guarantee usability. The goal was to combine the technical capabilities of language algorithms with a user-friendly design that can be easily used by the general population.

Current Stage of Chatbot Development

The current iteration employs a comparable methodology but incorporates differentiations, particularly in the gathering of data. Contrary to the previous model, this updated version utilizes its internet search skills to find essential information from authorized sources, particularly official publications from the Urban Development Authority of Sri Lanka. The interface development phase adhered to the fundamental goal of designing a user-friendly interface without any deviations. All alterations were in accordance with this overriding objective. The creation of this chatbot followed a systematic approach that integrated technology advancements with user-centered design and meticulous validation to offer planning assistance in Sri Lanka.

3.2 DEVELOPMENT PROCESS

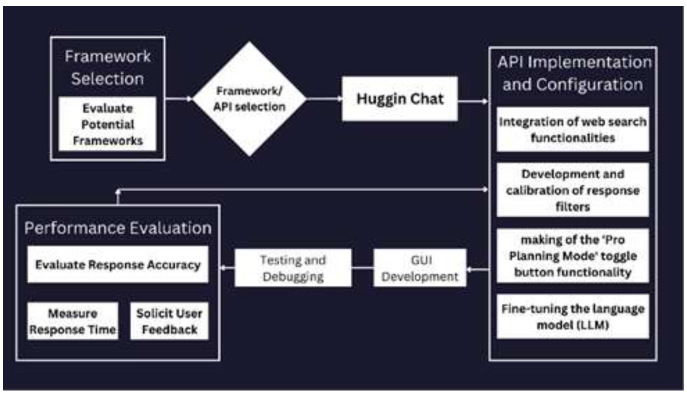

Figure 1 - Development Process

3.2.1. Framework Selection
The development process commenced with a meticulous evaluation of potential frameworks. An in-depth analysis was conducted to determine the most suitable framework for building the Chatbot. The primary objectives included cost reduction and efficient open-source options. Two prominent choices emerged from this evaluation,

- Rasa Framework - This framework allows developers to create Chatbots from the ground up, leveraging Python and Natural Language Understanding (NLU) capabilities.
- Hugging Chat API - Selected over Rasa for several reasons, including its compatibility with advanced language models like GPT-3.5, offering a richer and more extensive range of pre-trained models, and a reputation for ease of configuration, especially in the context of web querying.

3.2.2. Api Implementation and Configuration
With the Hugging Chat API chosen as the foundation, the subsequent phase was the practical implementation and configuration of the selected tool. Due to the relatively limited user base of this API, the development team paid particular attention to rigorous testing, thorough configuration, and iterative enhancements. This phase encompassed,

- Integration of web search functionalities.
- Development and calibration of response filters.
- Fine-tuning the LLM.
- Realization of the 'Pro Planning Mode' toggle button functionality.

3.2.3. Graphical User Interface (Gui) Development
The GUI was conceived and brought to life using the Flask Python framework. Signifying an essential element of the Chatbot's user-facing aspect, the GUI design process was marked by the relentless pursuit of an intuitive, user-friendly, and visually appealing interface. Guided by the principles of user-centered design and minimalism, the interface was crafted to facilitate the effortless input of queries, encouraging a natural and engaging conversational experience. The GUI, as the bridge between users and the Chatbot's core functionalities, offered seamless navigation and interaction, ensuring that users could easily access and leverage the Chatbot's capabilities.

3.2.4. Testing and Debugging
Rigorous and comprehensive testing was carried out as a pivotal phase of development. The entire Chatbot system underwent evaluation using various types of queries and within diverse scenarios. This rigorous testing process was executed to identify and address any encountered errors, ensuring that users would experience a seamless, error-free, and reliable interaction with the Chatbot.

3.2.5. Performance Evaluation
To gauge Chatbot's reliability and effectiveness, it was subjected to a rigorous performance evaluation. This evaluation spanned three critical dimensions

- Response Accuracy- The Chatbot's proficiency in delivering correct and pertinent responses to user queries was scrutinized.
- Response Time- Response generation times were measured to ensure that users experienced reasonably prompt interactions.
- User Satisfaction- User feedback was solicited and analyzed, employing a satisfaction rating scale to provide insights into the overall user experience and Chatbot's efficacy.

The development process encompassed not only the technical aspects but also meticulous planning, framework selection, iterative enhancements, user interface design, testing, debugging, and a comprehensive performance evaluation to ensure that the Chatbot met its objectives and delivered an exceptional user experience.

3.3 SYSTEM WORKFLOW

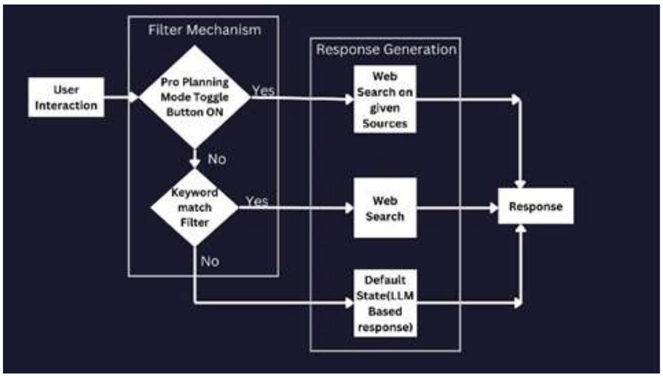

Figure 2 - Development Proces

User Interaction
Users initiate interaction by submitting questions or activating the **'Pro Planning Mode'** toggle to receive specialized urban planning information. When in this mode, the chatbot provides responses directly from pre-approved urban planning resources, including the following categories

- **Zoning Regulations-** Information on zoning laws and classifications for specific areas.
- **Development Policies-** Guidelines on permissible land use, building heights, and density limits.
- **Permitting Processes-** Steps and requirements for obtaining permits for different types of construction.
- **Sustainability Standards-** Regulations related to green building practices, energy efficiency, and environmental protection.
- **Heritage Sites and Protected Areas-** Information on areas with restricted development due to historical or ecological significance.

Filter Mechanisms

- **Pro Planning Mode Filter-** Monitors the 'Pro Planning Mode' toggle status. If enabled, the chatbot limits responses to verified data from Sri Lanka's Urban Development Authority (UDA), ensuring responses align with official urban planning standards.
- **Keyword Match Filter-** Screens user queries for specific urban planning keywords (e.g., "zoning," "permit," "policy"). Upon detecting these terms, the chatbot performs an online search to provide relevant references, enhancing the specificity of answers.

Default State
When neither of the specialized filters is active, the chatbot relies on its general language model. While responses are generated quickly with a high degree of linguistic accuracy, the currency and precision of information are limited to the language model's last training period (up to September 2022).

Response Generation
The Hugging Chat Python API powers the response process, using a language model (e.g., 'meta-llama/Llama-2-70b-chat-hf') that incorporates real-time online data retrieval when web search functionality is enabled. This feature enhances responses with the latest data where applicable, broadening the chatbot's ability to answer in-depth and contextually current urban planning questions.

4. Results

The assessment of Chatbot 1.0 involved a diverse group of participants, including urban planners, students, and the public. The feedback was largely positive, with 85% of users finding the interface user-friendly and 80% rating the information's relevance and accuracy as high. Chatbot 2.0 improved these metrics, reaching 90% and 88% respectively, thanks to real-time web search capabilities that 75% of users found made the information more comprehensive and up to date. Chatbot 1.0's ability to handle complex queries was recognized, with recommendations to expand its scope to topics like transportation and environmental impacts, and to increase interactivity. There were suggestions to make it a free or open-source application to boost accessibility and adoption. While respondents showed enthusiasm for the chatbot's potential impact on urban planning, they also acknowledged its limitations, such as its inability to sustain conversations or comprehend images and geospatial data. To overcome these, continuous improvements in contextual awareness and bias reduction are necessary, along with cost-effective solutions to make the chatbot an indispensable tool in urban development.

Chatbot 2.0 was developed with these improvements in mind, particularly in terms of functionality and accessibility. Its 'Pro Planning Mode' underwent extensive testing, showcasing its ability to provide accurate responses by accessing real-time data from authoritative sources, notably the UDA website. This integration ensures that the chatbot's knowledge remains current and wide-ranging, making it a valuable resource for professionals and academics alike. By utilizing real-time data extraction, Chatbot 2.0 delivers highly tailored responses, enhancing user customization and relevance. Its adaptability extends beyond urban planning, making it a versatile tool capable of solving complex mathematical and logical problems.

The GUI in version 2.0 provides a more comprehensive experience, allowing users to access full conversation histories, which was a limitation in Chatbot 1.0. The primary drawback of the earlier version was its dependence on pre-existing datasets, limiting its scope. Chatbot 2.0 addresses this by incorporating online search functionalities, which expand its knowledge base beyond urban planning. The chatbot now also identifies the sources of its responses, promoting transparency and trust while encouraging further exploration by users.

Chatbot 2.0's strengths include cost-effectiveness, achieved with open-source resources APIs and LLMs. This approach reduces financial strain on developers and ensures accessibility to a broader audience, making it a relevant tool in urban planning. The chatbot's ability to retrieve up-to-date information from the internet enhances its precision and adaptability, crucial in a field where regulations are continually evolving. Additionally, Chatbot 2.0 serves as a web application, further increasing its accessibility across diverse user groups. However, its limitations include the inability to be trained on user-specific data, as it relies on external sources and existing language models, which might not meet individual user needs. The chatbot's dependence on the Hugging Face Chat API also poses challenges, as it is susceptible to server failures and delays, potentially affecting its reliability. While AI tools like Chatbot 2.0 offer advantages in urban planning, it is essential to critically evaluate potential downsides. AI algorithms can inadvertently perpetuate biases present in training datasets, leading to skewed outcomes that may disproportionately affect certain communities. The effectiveness of AI tools also depends heavily on data quality and availability, which can be a significant limitation in regions with incomplete or outdated information. Privacy and security concerns arise from the collection of large amounts of data, requiring robust measures to prevent breaches. Additionally, over-reliance on AI can reduce human oversight and critical thinking in planning decisions, potentially overlooking nuanced insights that human experts provide. Financial constraints may also hinder the adoption of advanced AI systems in urban planning departments with limited budgets. Therefore, while Chatbot 2.0 shows promise for enhancing urban planning, a balanced approach that addresses these challenges is crucial for equitable and effective utilization.

Figure 3 – Chatbot Demonstration Example 1

Figure 4 - Chatbot Demonstration Example 2

5. Validation of Chatbot 2.0

The research team conducted a rigorous evaluation of Chatbot 2.0's effectiveness by engaging urban planning professionals from the Urban Development Authority (UDA). These experts, specializing in planning legislation and related fields, tested the chatbot by posing diverse queries on urban planning. Feedback was overwhelmingly positive, with professionals commending the chatbot's precision, comprehensive responses, and expertise in identifying land zones and zoning restrictions.

In addition to praise, the experts provided constructive feedback, emphasizing the need for a user input feature to specify locations before posing questions. They noted that such an enhancement would increase response accuracy, user-friendliness, and geospatial specificity, making the chatbot more relevant for both planners and the general public. The professionals collectively regarded this feature as essential for the chatbot's continued development and utility in real-world urban planning scenarios.

Performance Assessment - Quantitative Metrics
To objectively evaluate Chatbot 2.0, the following metrics were analyzed,

1. Response Accuracy - Responses were benchmarked against data from UDA publications, focusing on correctness, contextual relevance, and alignment with official guidelines.
2. Response Time - Average response times, tracked via system logs, decreased from 9 seconds in Chatbot 1.0 to 5.5 seconds in Chatbot 2.0, demonstrating improved efficiency.
3. Interactions per Session - Over 46 active sessions, data showed an increase in engagement, with each session representing a full interaction cycle.

Qualitative Feedback
Beyond quantitative data, qualitative insights were collected through open-ended surveys and interviews with key stakeholders. A total of 28 participants, including urban planners, government officials, community members, and academic researchers, contributed. All participants had relevant expertise in urban planning, ensuring the feedback was informed and practical. This input highlighted constraints in Chatbot 1.0, while offering recommendations to address complex contextual queries and integrate more up-to-date information.

Comparative Analysis and Improvement Metrics
Chatbot 2.0 demonstrated significant advancements over its predecessor, as evidenced by:

1. Precision and Recall Rates - Chatbot 2.0 achieved a precision rate of 92% and a recall rate of 89%, compared to Chatbot 1.0's 85% precision and 81% recall.

2. User Satisfaction - Post-interaction surveys showed that 91.2% of users rated their experience as satisfactory or highly satisfactory (4 or 5 on a 5-point Likert scale), up from 84.6% for Chatbot 1.0.
3. Engagement Duration - Interaction times increased by 23%, indicating greater user interest and willingness to engage with Chatbot 2.0.

Enhanced User Experience
The introduction of a refined graphical user interface (GUI) and the innovative 'Pro Planning Mode' significantly improved user-friendliness and functionality. These features enhanced the chatbot's relevance, providing a more tailored and informative experience for urban planning professionals and general users alike.

In conclusion, the validation and performance metrics underline Chatbot 2.0's substantial progress. Feedback from professionals and stakeholders provides a solid foundation for further development, ensuring the chatbot continues to meet the evolving needs of the urban planning community.

OBSERVATIONS AND SUGGESTED ENHANCEMENTS
Participants commended Chatbot 2.0 for its conversational interface, which improved engagement and made interactions intuitive. Many users found it particularly effective in clarifying local urban planning regulations. However, several enhancements were suggested to boost its functionality and adaptability.

Key recommendations included integrating **real-time interactive maps** to display zoning areas, development zones, and similar spatial elements, aiding spatial understanding. Users also requested **simulated scenario features** to explore hypothetical changes in urban planning, such as zoning adjustments or new development proposals, and visualize their impacts. An **in-chat feedback tool** was proposed to enable users to rate responses and provide immediate input for improvements. Additionally, participants highlighted the need to expand the chatbot's knowledge base to cover related fields such as environmental impact assessments, public transportation planning, and sustainability metrics.

Future improvements could focus on training the chatbot with **proprietary data**, reducing its reliance on online searches and external APIs like Hugging Face. This approach would enhance accuracy, control, and reliability, tailoring responses to domain-specific needs and mitigating performance inconsistencies. Expanding input and output capabilities to include **image-based queries and responses** would improve versatility, enabling the chatbot to process visual information and align with modern AI trends. Incorporating **geo-location data** was also suggested to provide location-specific insights, making the chatbot more relevant and useful for urban planning scenarios.

6. Discussion

The integration of AI in urban planning significantly enhances citizen engagement, information distribution, and data-driven decision-making, as noted by Caragliu et al. (2011) and Yigitcanlar et al. (2021). The transition from Chatbot 1.0 to 2.0, featuring advanced tools like the Hugging Chat API and real-time web search, exemplifies how AI can improve the efficiency and inclusivity of urban planning processes. This shift reflects broader AI urbanism trends where technologies, such as autonomous vehicles and AI-driven planning tools, are transforming urban governance (Cugurullo et al. 2022). By incorporating real-time data from authoritative sources like Urban Development Authorities (UDA), Chatbot 2.0 not only enhances decision-making accuracy but also supports the development of resilient, sustainable, and equitable urban environments. This aligns with concepts of intelligent urban areas (Rudolf et al. 2010) and smart urbanism (Caprotti et al. 2022).

Furthermore, the application of NLP and ML algorithms in Chatbot 2.0 addresses the need for adaptive and responsive urban planning tools, as discussed by Batty (2018). The ability of Chatbot 2.0 to provide tailored responses based on current urban data illustrates AI's practical role in fostering participatory planning processes, a key element in modern urbanism literature (Foth et al. 2013). This democratizes access to urban planning information, empowering citizens to shape their environments. Thus, this study highlights AI's potential to create smarter, more responsive urban systems, aligning with the evolving needs of urban communities.

7. Conclusion

The upgrade from Chatbot 1.0 to 2.0 marks a substantial advancement in urban planning Chatbots, resolving prior shortcomings while integrating the latest AI technology and user-focused design. Chatbot 2.0 is a significant resource for urban planners, researchers, students, and the general public due to its cost-effective solutions, achieved by leveraging open-source resources like APIs and LLMs. This approach ensures accessibility and feasibility for development teams and a broad audience. A major enhancement in Chatbot 2.0 is its online search capability, enabling real-time material retrieval from authoritative sources and keeping its knowledge base current. This makes the Chatbot an essential tool for users seeking the latest urban planning advancements. Integrating LLMs improves Chatbot 2.0's adaptability and conversational abilities, allowing users to engage in dynamic, human-like interactions. This transforms the Chatbot from a mere information retrieval tool into a conversational companion. Despite its advancements, Chatbot 2.0 has some limitations. Its reliance on online information and pre-programmed LLMs, rather than exclusive user data training, might hinder efficiency in specialized tasks. Dependence on the Hugging Face Chat API can lead to potential issues like server failures, affecting dependability. For future enhancements, several strategies could further improve the Chatbot: training on user-specific data, reducing reliance on third-party APIs, supporting image-based inquiries, integrating geo-location data, and implementing a feedback system. These improvements would broaden the Chatbot's capabilities and user-centricity, catering to diverse user needs.

Chatbot 2.0 signifies a notable advance in urban planning tools, prioritizing user-centric design to surpass previous constraints, providing enhanced accessibility, versatility, and information. It is poised to become indispensable for urban planning professionals and enthusiasts, offering vital knowledge in the evolving field of urban development. The transition from Chatbot 1.0 to 2.0 highlights the progress and possibilities of AI-powered urban planning solutions. The Chatbot's online search capabilities and real-time data access enhance urban planners' efficiency and productivity by providing up-to-date information on zoning rules and land use policies. This makes it a valuable tool for students, professionals, and public participation, promoting transparency in decision-making and aiding emergency preparedness. Its cost-effectiveness ensures accessibility for planning departments with limited resources. The feedback mechanism allows continuous improvement, making it invaluable for the urban planning community, contributing to efficient, data-driven, and inclusive practices.

Future research in AI Chatbots for urban planning offers promising directions. Personalizing Chatbots to user-specific needs, enhancing NLP and NLU models, and supporting multimodal communication are key areas. Integration with geospatial intelligence and smart city initiatives is vital, as are considerations for feedback and privacy. Prioritizing collaborative planning, scalability, and impact evaluation will maximize AI Chatbots' potential in transforming urban planning methods, enhancing efficiency, decision-making, and user-friendliness.

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Corrections Made

Reviewer Comment	Correction Made	Location in Document
1. Clearer articulation of the research problem and objectives.	Clarified gaps in current urban planning systems and explicitly outlined how the chatbot addresses these issues. Revised study objectives to reflect these gaps.	**Introduction** section: Added a clearer statement of the research problem and objectives towards the end of the introduction.
2. Relocate methodology and results under appropriate sections.	Rearranged content from the **Related Work** section to ensure methodology justifications and results were moved to respective sections.	Adjusted **Related Work**, **Methodology**, and **Results** sections.
3. Literature review expansion on AI in urban planning.	Added references to global AI applications and their implications for Sri Lanka and emerging economies.	**Literature Review**, under **The Significance of AI Chatbots in Urban Planning**.
4. Define Likert scales more clearly.	Defined scales used for user satisfaction and significance measures.	**Methodology**, under **User Feedback Analysis**.
5. Clarify Likert scale findings and ensure consistent terminology.	Clarified terminology and perspectives of analysis for Likert scale findings.	**Methodology**, under **Key Findings from Feedback Analysis**.
6. Methodology lacks details on quantitative metrics.	Expanded details on response accuracy evaluation, response time sources, and session criteria.	**Methodology**, under **Performance Evaluation**.
7. Provide a respondent profile for qualitative feedback.	Added details on the background, number, and eligibility criteria of participants.	**Methodology**, under **Qualitative Feedback**.
8. Specify interactive elements proposed by users.	Detailed user suggestions such as real-time maps and simulated scenarios.	**Observations and Suggested Enhancements**.
9. Distinctly separate methods and results.	Created distinct subsections for methodology and results, ensuring clear presentation.	**Methodology** and **Results** sections were restructured for clarity.
10. Clarify activity flow in Figure 1.	Revised Figure 1 to include clear activity flow with appropriate annotations.	**Figure 1 - Development Process**.
11. Clarify the purpose of Figure 2.	Indicated whether Figure 2 represents the development process or system workflow.	**Figure 2** caption updated accordingly.
12. Provide in-text citations for IT platform justifications.	Added relevant citations for the choice of IT platforms and technologies.	Throughout the **Methodology**, particularly under **Framework Selection** and **API Implementation**.
13. Clarify specific information users can retrieve.	Added examples of urban planning information categories users can access.	**System Workflow** section under **User Interaction**.
14. Add captions for all figures.	Provided descriptive captions for all figures.	Added under **Figure 1**, **Figure 2**, **Figure 3**, and **Figure 4**.
15. Rephrase section heading for results.	Adjusted the heading to reflect results only, leaving discussion for the separate section.	Renamed **Results and Discussion** to **Results**, and ensured discussions were reserved for the **Discussion** section.
16. Divide large paragraphs for readability.	Reformatted sections with long paragraphs into smaller, more readable chunks.	**Results**, **Validation**, and **Discussion** sections.
17. Clarify sources of suggestions for future improvements.	Moved validation section before suggestions and linked suggestions explicitly to validation findings.	**Validation of Chatbot 2.0** placed before **Suggestions for Future Improvement**; justification for suggestions updated.
18. Clarify "highly satisfactory" in user feedback.	Defined what constitutes "satisfactory" (4) and "highly satisfactory" (5) on the Likert scale.	**Validation**, under **User Satisfaction and Engagement**.
19. Rename "Citations and References" to "References".	Updated section heading.	**References** section renamed from **Citations and References**.
Overall structure improvements.	Improved the flow by addressing scattered results and multiple discussion sections.	Throughout the document, particularly in **Results**, **Discussion**, and **Suggestions for Future Improvement**.