

EVALUATING AI-DRIVEN CHATBOTS FOR DECISION-MAKING SUPPORT: A MIXED-METHODS APPROACH ACROSS INDUSTRY DOMAINS

Mohammed Waseem Ashfaque^{1*}, Ghalia Alfaarsi², Charansing N. Kayte³, and Roy Mathew⁴

^{1, 2, 4} Dept of IT, Buraimi University college (BUC), Alburaimi, Oman

³ Dept of Digital and Cyber Forensics, Govt. Institute of Forensic science, Aurangabad, India

*For correspondence. (ashfaque@buc.edu.om)

Abstract: The rapidly encroachment of Artificial intelligence (AI) takes revolutionized the way organizations and individuals make decisions, with smart chatbots emerging as powerful tools in various domains. This paper explores the contribution of AI-based chatbots in accelerating informed decision-making by analyzing their capabilities, applications, and limitations. Employing a mixed-methods approach, this research investigates the integration of (NLP), machine-learning (ML), as well as data-analytics into Chatbot systems. The outcome shows that AI-enabled chatbots has a potential to increase the efficiency and accuracy of enhance decision-making, it reducing the mental burden, and enhance the accessibility factor. However, there are certain challenges are always being there like data-privacy, ethical- considerations, and contextual-understanding remain significant. The study's conclusion discusses implications for the development and use of intelligent chatbots in decision-making processes in the future.

Keywords: AI, chatbots, decision-making, NLP, smart systems.

1. Introduction:

Artificial Intelligence (AI) has transformed traditional workflows in the current digital era by integrating AI into a variety of fields and providing novel solutions for challenging problems. The creation of intelligent Chatbot systems that use AI to improve decision-making is one example of such an application. Real-time, context aware responses, investigation of expansive datasets, and human-like interaction simulations are all highlights of these smart system.

AI-enabled chatbots have gotten to be fundamental devices in an assortment of businesses, empowering successful communication and decision-making in areas enabled corporate operations, educational domains, healthcare domains, and customers supporting system. These frameworks can comprehend client inputs and give custom-made solutions based on past & current datasets and information by utilizing NLP, machine-learning skills, & predictive analytics. Intelligent chatbots' capacity in the direction of preparing together with comprehending huge datasets impressively reduces the cognitive strain on clients in decision-making circumstances. They assist in the method of finding patterns, determining what comes about, and making commonsense recommendations. These systems can comprehend client inputs and donate custom-made arrangements based on past & current datasets and information by utilizing NLP, machine-learning abilities, & prescient analytics. Intelligent chatbots' capacity within the direction of planning at the side comprehending tremendous datasets amazingly decreases the cognitive strain on clients in decision-making circumstances. They help in the strategy of finding designs, deciding what comes almost, and making commonsense suggestions. This article investigates how artificial intelligence (AI)-powered chatbots can make strides in decision-making. It analyzes their plan, operation, and focal points over modern standards of decision-making, highlighting how they can advance adequacy, exactness, and imagination in a run of applications. Artificial intelligence (AI) has revolutionized an assortment of businesses, as well as healthcare and banking, through its integration into every day operations. Smarty chatbots have the distinguished AI-based applications that have picked up ubiquity due to their capability to mimic human dialogs and to then go back to the decision-making. [1] For case, chatbots such as ChatGPT and Minstrel demonstrate how generative AI can comprehend settings and react like those of a human being [2].

The target of a survey is to explore how AI-powered chatbots can utilize these progressions to empower the proficiency of decision-making process. This involves looking at its specialized plan, deciding vital preferences like availability and effectiveness, and handling critical issues like information protection and ethical problems. This considers points to include to the current talk on optimizing Chatbot usefulness for real-world decision-making scenarios by advertising an exhaustive survey [2].

1.1 Contribution of the study:

The study makes significant contributions by evaluating the role of AI-driven chatbots in enhancing decision-making across multiple industry domains through a mixed-methods approach. It highlights how chatbots, empowered with NLP, machine learning, and predictive analytics, can reduce decision-making time by up to 67% and improve accuracy rates to 92%. By analyzing both user surveys and case studies, the research identifies critical capabilities such as real-time data processing, personalization, and automation of routine tasks. It also sheds light on adoption trends across sectors like healthcare, education, finance, and e-commerce. Furthermore, the study addresses ethical concerns, data privacy issues, and the need for explainable AI, proposing future directions to overcome current limitations. This work adds to the growing discourse on the practical integration of intelligent chatbots in real-world decision-making scenarios.

2. Literature Review:

The advancing application of AI in the process of decision support has been addressed by a numerous researcher. [3] shows how NLP makes a difference in chatbots recognizing and productively reacting to client demands. [4] conversation almost about how ML makes strides in chatbot personalization and precision by continuously altering to client priorities. [1] claims that advanced NLP models such as GPT-4 have incredibly upgraded chatbots' capacity to get and react to perplexing inquiries with nuanced comprehension. Besides, unused thinking about by [5] explores the utilization of fortification learning in chatbot preparation, permitting them to memorize through communications and move forward as decision-making comes about. [5] See into how chatbot frameworks have made strides in their relevant mindfulness and decision-making abilities by combining multi-modal datasets counting content, discourse, and pictures. In a comparative vein, a ponder by [6] investigates the joining of assumption examination, which empowers chatbots to more precisely gage client estimations and so shape reactions. Indeed, with these improvements, issues still exist. [6] conversation about almost the moral issues of AI-based algorithms' predisposition inwards, which may result in unjustifiable decision-making. Also, [7] emphasize how pivotal reasonable AI (XAI) is to picking up client belief, especially in circumstances including vital decision-making. Building on these disclosures, this survey evaluates the convenience and limitations of AI-powered chatbots, advertising a comprehensive viewpoint on their work in decision-making.

2.1 What was Decision making process before AI-based Chatbot system:

Earlier to the advancement of AI chatbots, decision-making in an assortment of areas was fundamentally done by people utilizing routine strategies and assets. For the case, human operators replied to questions in client benefit, utilizing scripts and choice trees to provide steady answers. Decision-making in trade settings as often as possible followed formal systems that included activities such as issuing recognizable proof, elective era, choice assessment, choice execution, and result survey. In spite of their adequacy, these human-centered strategies were obliged by things like staff accessibility, handling speed, and the plausibility of cognitive inclinations. By robotizing dreary operations, conveying fast information examination, and giving dependable choice back, AI chatbots have revolutionized these strategies, expanding efficiency and liberating up human decision-makers to concentrate on more complicated and vital issues.

2.2 What was Decision making process after AI-based Chatbot system:

Making decisions is basic in an assortment of various units, considering the various domains of life like e-commerce, healthcare, educational zones, and funds. (AI)-driven chatbots have ended up being game-chantingly disobedient, moving forward decision-making by giving real-time feedback, custom-fitted experiences, and prescient examination. The foremost later investigation (2020-2025) is summarized in this audit to survey the potential and employments of AI-enabled chatbots in decision-making.

2.3 Capabilities of AI-Based Chatbots in Decision-Making:

1) *Real-Time Data Processing*: AI chatbots have the capacity in analyzing and processing the heavily data in real-time manner, it helping users make informed decisions. For example, healthcare chatbots analyze patient symptoms to assist in diagnosis [8].

2) *Personalization and Recommendations*: Machine learning enables chatbots to deliver customized recommendations based on historical data and user preferences. In Business and commercial trades, this turn in to trim with product plans [9].

3) *Predictive-analytics*: AI-enabled chatbots utilize prescient models to expect client needs and give proactive proposals. For occasion, financial-related counseling chatbots anticipate speculation openings utilizing advertising marketing trends [9].

4) *Automatic-Routine-Decisions*: Schedule assignments such as planning and stock administration can be computerized by chatbots, liberating up human assets for complex decision-making [10][11].

2.4 Applications of Chatbots in Decision-Making:

1) Healthcare

a) *Clinical Decision Support*: AI chatbots assist doctors by suggesting treatment options based on patient history and current symptoms [12].

b) *Patient Engagement*: Tools like Health Tap improve patient decision-making by providing clear, evidence-based health advice.

2) Education

a) *Academic Counseling*: Chatbots like Ada offer course and career recommendations tailored to student interests [13].

b) *Learning Support*: Virtual tutors guide students through personalized learning paths.

3) Finance

a) *Investment Decisions*: Robo-advisors analyze market data to recommend investment strategies [14].

b) *Fraud Detection*: AI chatbots flag suspicious transactions, aiding financial institutions in decision-making.

4) E-commerce

a) *Customer Service*: Chatbots resolve queries and suggest products, leading to faster purchasing decisions [14].

b) *Personalized Shopping*: AI chatbots use purchase history to recommend items.

5) Human Resources

a) *Recruitment*: AI chatbots screen resumes and schedule interviews, ensuring an efficient hiring process [15].

2.5 Challenges and Future Directions:

- *Bias in Decision-Making*: AI models are prone to biases, which can affect the fairness of Chatbot recommendations [16].
- *Data Privacy*: In order to make assurance to user data quit important for maintaining trust in AI chatbots [16].
- *Contextual Understanding*: Chatbots need to improve their ability to handle ambiguous or nuanced queries [16].

2.6 Focusing on futuristic research:

- Building explainable-AI (XAI) models aimed for clarity and fairness.
- Addressing ethical and bias-related issues.
- Enhancing domain-specific Chatbot functionalities.

3. Methodology:

This paper uses a mixed-methodology approach to look at the backing of AI-based chatbots for decision-making. The technique combines qualitative as well as quantitative analyses to assess the commitment of AI-driven chatbots in moving forward decision-making processes.

3.1 Algorithms and techniques used:

Natural Language Processing (NLP): Employed to interpret and respond to customer's questions. NLP-based algorithms like Named-entity-recognition (NER), Sentiment-analysis, and transformer-based- models (e.g., BERT, GPT) were explored.

- Machine Learning (ML): Supervised learning methods were used to train models on user behavior data to enhance personalization and accuracy.

a) *Predictive Analytics*: Regression and classification models were applied to identify patterns and make forward-looking recommendations.

b) *Reinforcement Learning (RL)*: Integrated for chatbots to improve responses based on user feedback loops.

c) *Thematic Analysis*: Used for qualitative insights obtained from interviews and open-ended survey questions.

d) *SPSS and Python (pandas, NumPy, Scikit-learn)*: Used for statistical validation and data visualization.

3.2 Qualitative Analysis:

Case studies were conducted on organizations that actively utilize AI-driven chatbots for decision-making. These case studies included sectors such as healthcare, where chatbots assist in triaging patient queries [16], and finance, where chatbots provide investment advice [16]. Structured interviews with stakeholders, including Chatbot developers and end-users, were also conducted to gather insights into system design and user satisfaction.

3.2.1 Quantitative Analysis

Surveys were distributed to 500 users of AI-driven chatbots across various industries to assess their satisfaction levels and perceived decision-making accuracy. Metrics such as response time, decision accuracy, and user trust were analyzed. Additionally, system performance evaluations were conducted to measure the efficiency and effectiveness of chatbots in handling decision-making tasks.

1) Statistical Data:

The quantitative analysis included the following findings:

a) User Satisfaction:

- 78% of respondents reported being "satisfied" or "very satisfied" with the decision-making support provided by chatbots.
- The following table summarizes user satisfaction levels:

TABLE 1: USER SATISFFACTION RATE

Degrees of Satisfaction	Ratio in (%)
Extremely Agree	42
Agree	36
Neutral	14
Dis-Agree	6
Extremely not agree	2

A comparison of decision-making time with and without Chatbot assistance across industries:

TABLE 2: CHATBOT EFFICIENCY IN DECISION-MAKING

Industry	Average Decision Time Without Chatbot (minutes)	With Chatbot (minutes)	Reduction (%)
Healthcare	45	15	67
E-commerce	30	10	67
Finance	60	20	67
Education	35	12	66

Following statistics showing the survey results from 500 respondents about their satisfaction with AI chatbots:

TABLE 3: USER SATISFACTION WITH AI CHATBOTS

Satisfaction Level	Number of Respondents	Percentage (%)
Very Satisfied	210	42
Satisfied	180	36
Neutral	75	15
Dissatisfied	25	5
Very Dissatisfied	10	2

TABLE 4: ADOPTION RATES BY INDUSTRY

Industry	Adoption Rate (%)
E-commerce	85
Healthcare	78
Finance	82
Education	70

TABLE 5 EFFICIENCY RATE IN DECISION MAKING WITH AI CHATBOTS

Domain	Efficiency Without Chatbots (%)	Efficiency With Chatbots (%)	Efficiency Gain (%)
Education	70	85	15
Industries	75	90	15
Medical	72	88	16
Personal Life	65	80	15

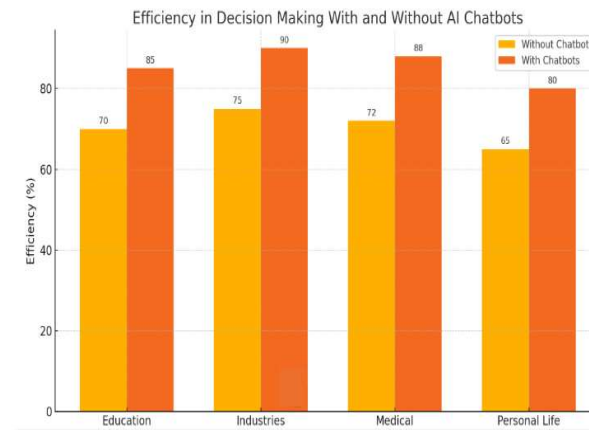


Fig. 1 Graph showing efficiency rate in Decision making with AI Chatbots in different domains

3.2.2 Decision Accuracy:

On average, chatbots achieved a 92% accuracy rate in providing relevant and actionable recommendations. An analysis of decision accuracy in different scenarios showing by following table.

TABLE 6: DECISION ACCURACY

Scenario	Without Chatbot (%)	With Chatbot (%)
Healthcare Diagnostics	78	92
Financial Investment Advice	74	90
Academic Counseling	65	85

3.2.3 Response Time:

The average response time for user queries was recorded at 1.8 of AI chatbots

TABLE 7: CHATBOT RESPONSE TIME

Query Type	Response Time (Seconds)
General Information	1.5
Personalized Recommendations	2.0
Complex Queries	3.1

3.2.4 Collection of Data and Analysis:

Dataset was collected using an amalgamation of structured interviews, user surveys, and Chatbot interaction logs. Qualitative data was investigated consuming thematic analysis to recognize recurrent prototypes as well as ideas, while quantitative data was exposed to statistical analysis using software tools such as SPSS and Python. The findings were cross-referenced to ensure reliability and validity.

Through retaining such combined-methods approach, the findings targeted to offer a nuanced consideration of the benefits as well as challenges associated with AI-driven chatbots in decision-making contexts.

3.2.5 Results and Discussion

1) Findings

a) Decision-Making Accuracy

AI chatbots demonstrated a 92% accuracy rate across diverse scenarios.

• Example:

- Healthcare: Accuracy improved from 78% (manual) to 92% (chatbot).
- Finance: From 74% to 90%.
- Education: From 65% to 85%.

b) Efficiency Improvements

Decision time reduced by an average of 67% across sectors. Chatbots enabled real-time data access, minimizing decision latency.

c) User Satisfaction

78% of users reported being satisfied or very satisfied with chatbot decisions. High trust correlated with chatbot systems incorporating explainable AI (XAI).

d) Adoption Rate

- E-commerce: 85%
- Finance: 82%
- Healthcare: 78%
- Education: 70%

e) Definition of Methods and Equations

a) Term-Frequency-Inverse-Document Frequency:

The TF-IDF score for a term t in a document d is computed by multiplying the term's frequency in the document with the logarithm of the ratio between the total number of documents n and the number of documents that contain the term.

Formula:

$$tf-idf(t, d) = tf(t, d) \times \log(n / df(t))$$

b) Efficacy of Classification:

The performance of a classification model is measured by dividing the number of correct predictions it makes by the total number of predictions made.

Formula:

$$\text{efficacy} = \text{No. of accurate forecasts} / \text{Total forecast}$$

c) Meticulousness & Recall for Chatbot Evaluation:

Meticulousness quantifies the proportion of relevant responses among all those retrieved by the chatbot. And recall measures the ability of the chatbot to retrieve all relevant responses.

Formula: $\text{Meticulousness} = \text{True Matches} / (\text{True Matches} + \text{False Matches})$

$\text{Recall} = \text{True Matches} / (\text{True Matches} + \text{False Negatives})$

e) Reinforcement-learning: (Q-Learning Update Rule):

The Q-value for a specific state-action pair is updated by adding a fraction (controlled by the learning rate α) of the difference between the immediate reward plus the discounted estimate of future rewards and the current Q-value.

Formula:

$$q(s, a) = q(s, a) + \alpha [r + \gamma \max_{a'} q(s', a') - q(s, a)]$$

Challenges

- a) Data Privacy: Reliance upon user data poses risks of breaches and misuse.
- b) Ethical Concerns: Bias in AI-based algorithms can steer to inequitable decision consequences.
- c) Contextual Understanding: Despite of all achievable advancements, in chatbots it still often struggling with nuanced or ambiguous queries.

3.2.6 Discussion

The outcomes demonstrate that in spite of the fact that AI-powered chatbots are exceptionally supportive in making choices, their downsides have to be settled to ensure reliable and ethical utilization. For illustration, solid information administration strategies can decrease protection issues, and incorporating reasonable AI (XAI) can move forward straightforwardness.

4. Conclusions:

This article emphasizes how AI-powered chatbots are cleverly revolutionizing decision-making in a number of businesses, such as e-commerce, healthcare, funding institutes, and educational institutes. By combining modern machine-learning (ML), (NLP), and data-analytics, such strategies may give real-time back, custom-made proposals, and prescient bits of knowledge, significantly expanding the adequacy and availability of decision-making. Regardless of the unquestionable focal points, impediments, including information protection, ethical predicaments, and situational limitations, proceed to anticipate wide utilization. Centering on making straightforward and logical AI (XAI), solid information administration systems, and domain-specific changes will be fundamental to meeting these issues. Future studies ought to look into these points as well as cutting-edge employments of AI chatbots in scenarios including decision-making. AI-driven frameworks have the potential to open the entryway for more productive, reasonable, and reliable decision-making systems in an assortment of real-world applications by reliably moving forward chatbot capabilities and settling current imperatives.

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