RESEARCH PROJECT REPORT

On

A Study on E-Commerce Chatbot Security, Memory Performance, and Complex Query Handling for Consumer Satisfaction

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EXECUTIVE SUMMARY

This project focuses on how e-commerce chatbots perform in three main areas: security, memory, and handling complex user queries. Chatbots are used by online shopping websites to assist customers with tasks such as finding products, solving issues, and answering questions.

The study was conducted through a survey of 160 e-commerce users in India, and the responses were analysed using percentage analysis and the Chi-Square test. The findings reveal that 63.7% of users are not comfortable sharing sensitive information with chatbots, showing a clear lack of trust in data privacy. Additionally, 59.4% of users reported that chatbots forget past conversations, leading to repeated questions during interactions. When faced with difficult or uncommon queries, 76.9% of users prefer human assistance instead of relying on chatbots.

Although users find chatbots helpful for simple and quick tasks, overall satisfaction remains moderate due to the lack of personalization and emotional understanding. On a positive note, users show strong trust in AI-based security features, such as fraud detection and digital verification systems.

The study suggests that e-commerce platforms should focus on improving chatbot security, contextual memory, and ability to understand complex queries. Adding emotion-aware responses and using a hybrid model that combines chatbots with human support can lead to a more reliable and satisfying user experience.

CHAPTER - 1



INTRODUCTION

1. INTRODUCTION

1.1 Background

E-commerce is one of the fastest-growing parts of the global economy and has changed how businesses interact with customers. One of the key technologies used today is chatbots, which help businesses save time, reduce costs, and offer 24/7 customer support. Chatbots use Artificial Intelligence (AI), including Natural Language Processing (NLP) and Machine Learning (ML), to understand customer questions and provide suitable responses. They assist with tasks such as tracking orders, recommending products, and resolving basic issues.

Studies indicate a significant rise in chatbot adoption, highlighting their growing importance in e-commerce customer service. This highlights the growing importance of chatbots in online business operations.

However, despite these advantages, chatbots still face three major challenges:

1. Memory problems – Memory limitations – Many chatbots fail to retain previous interactions, leading to repetitive or incomplete responses.
2. Security risks – Chatbots may be vulnerable to phishing attempts or data misuse, which reduces user trust.
3. Difficulty with complex queries – Chatbots often fail to answer unusual or complicated questions, causing user dissatisfaction.

1.2 Identification of the Problem

This study examines the overall functioning and reliability of e-commerce chatbots from a user perspective. The focus is on three major areas:

- Memory performance – Do chatbots remember past conversations?
- Security – Are users and their data safe during chatbot interactions?
- Handling complex queries – Can chatbots answer complicated or unique user questions?

Most earlier studies have examined these issues separately, and very few have analysed all three aspects collectively, which means there is limited understanding of how these combined factors influence user trust and satisfaction.

1.2.1 Research Gap

Previous research primarily focuses on chatbot security, memory, or complex query handling as separate components. There is very limited research that studies all three factors together and examines their combined impact on user trust and satisfaction in e-commerce. This study fills that gap by analysing all three components in a single framework.

1.3 Significance of the Study

This study is important for two reasons:

A. Theoretical Significance

It enhances understanding of human–computer interaction by examining how chatbots manage memory, maintain security, and handle complex conversations.

B. Practical Significance

It provides useful insights for online businesses to enhance their chatbot systems by:

- Improving memory for more personalized conversations
- Strengthening security to prevent scams and fraud
- Enhancing intelligence so chatbots can answer complex questions effectively

1.4 Purpose of the Study

The purpose of the study is to assess chatbot performance in e-commerce and suggest improvements in three major areas:

- Memory – Understanding how weak memory affects users and how AI-based memory can improve interactions
- Security – Identifying security risks and suggesting better protection methods
- Complex Query Handling – Examining how well chatbots manage difficult questions and recommending improvements

1.5 Research Aim

The aim of this research is to evaluate the effectiveness, reliability, and user satisfaction of e-commerce chatbots, how secure they are, and how satisfied users are with them. The study focuses on chatbot memory ability, security issues, and performance in handling complex user queries.

1.6 Objectives of the Study

1. To study chatbot memory limitations and identify methods to improve them.
2. To examine security risks such as phishing and suggest possible solutions.
3. To assess user satisfaction with chatbot performance in handling complex queries.

1.7 Technical Aspects and Framework

Understanding chatbot performance requires knowledge of the technical components that support them.

A. Technical Aspects

1. Artificial Intelligence (AI)

AI acts as the core engine of a chatbot. AI helps the system think, learn from conversations, and respond like a human.

2. Natural Language Processing (NLP)

NLP helps chatbots understand human language, analyse meaning, and reply accurately. Advanced models like GPT and BERT improve this capability.

3. Machine Learning (ML)

ML enables chatbots to learn from past interactions and improve their responses over time.

4. Memory System

Chatbots may have short-term memory (current chat) or long-term memory (user preferences, past orders). An effective memory system enhances personalization and conversational continuity.

5. Security and Data Protection

Chatbots use encryption (SSL/TLS), secure login methods, and fraud-detection AI to protect user data and prevent scams.

6. Understanding Complex Questions

Chatbots use tools like intent recognition and emotion detection to handle difficult or sensitive queries more effectively.

7. Integration with Other Systems

APIs and cloud services connect chatbots with websites, apps, and databases, helping them provide accurate, real-time information.

B. Conceptual Framework of the Study

The study examines how three independent variables affect user satisfaction and trust:

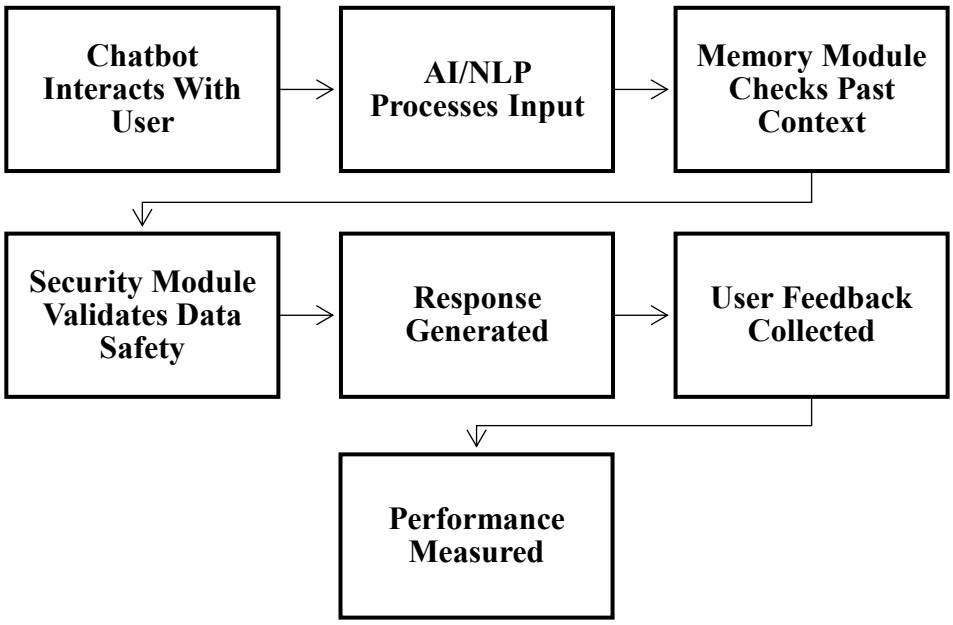
Independent Variables

- Chatbot Security (data protection, fraud detection)
- Memory Performance (ability to remember context)
- Complex Query Handling (accuracy and completeness of responses)

Dependent Variable

- User Satisfaction and Trust in chatbot systems

1.8 Flow of Chatbot Functional Framework



CHAPTER - 2



LITERATURE REVIEW

2. LITERATURE REVIEW

Name of Journal	Title of the Paper	Author(s)	Theme
Journal of Information Security Research	Security Vulnerabilities in AI Chatbot Ecosystems	Ryu & Baek (2022)	Explores security risks in chatbots including phishing, weak authentication and data privacy issues.
Journal of Information Security	Secure Conversational AI in Retail E Commerce	Kumar, Patel & Shah (2021)	Explains how stronger encryption reduces chances of data leakage and increases user trust.
International Journal of Cybersecurity	Machine Learning Based Detection of Malicious Chatbot Interactions	Sahu & Yadav (2020)	Shows how machine learning can detect suspicious chatbot activity and prevent fraud.
Journal of Business Ethics	GDPR Compliance in AI Powered Customer Chatbots	Patil & Sheth (2021)	Studies the importance of user consent, transparency and ethical data handling in chatbots.
IEEE Access	Blockchain Enabled Chatbot Authentication	Sharma & Singh (2023)	Proves that blockchain improves authentication, increases data integrity and builds user trust.
Journal of Cybersecurity	Real Time Link Verification in Chatbots	Khan, Ahmed & Ullah (2023)	Discusses how real time link checking reduces phishing and protects users.

Name of Journal	Title of the Paper	Author(s)	Theme
Journal of AI and Digital Commerce	Secure and Adaptive AI Chatbots	Choudhary & Patel (2023)	Covers intelligent security systems and advanced threat detection in chatbots.
Neural Computing and Applications	Transformer Based Neural Conversation Systems	Huang, Zhang & Li (2019)	Shows that transformer models improve chatbot memory and conversation continuity.
International Journal of Machine Learning Studies	Contextual Memory in LSTM Based Conversational Agents	Ghosh & Banerjee (2020)	Explains how LSTM improves chatbot ability to remember previous interactions.
AI Review	BERT Enhanced Memory Mechanisms in E Commerce Chatbots	Zhang, Lin & Wu (2022)	Demonstrates how BERT improves memory recall and personalized responses.
Information Systems Frontiers	CRM Integrated Chatbots for Enhanced Personalization	Kim & Lee (2021)	Studies how integrating CRM helps chatbots remember user details and improve personalization.
Expert Systems with Applications	Challenges in Long Term Chatbot Memory	Nguyen & Park (2023)	Explores why chatbots struggle with long term memory retention.
International Journal of E Business Studies	Integrated Security and Memory Optimization in Conversational AI	Singh, Mehta & Dey (2024)	Provides a combined framework linking security, memory and complex query handling.

Name of Journal	Title of the Paper	Author(s)	Theme
Journal of Intelligent Information Systems	Multi Intent Classification for E Commerce Chatbot Systems	Jain, Kapoor & Sharma (2018)	Shows that chatbots struggle with multiple intentions inside a single query.
Journal of Computational Linguistics	Improving Complex Query Understanding Using BERT Based Models	Wang & Luo (2020)	Explains how BERT improves understanding of complex customer questions.
Information Fusion	Emotion Recognition in Conversational AI	Poria, Cambria & Hazarika (2019)	Shows how emotion recognition improves chatbot responses and reduces user frustration.

CHAPTER - 3



RESEARCH METHODOLOGY

3. RESEARCH METHODOLOGY

3.1 Research Design

This study follows a descriptive research design aimed at understanding the opinions and experiences of e-commerce users regarding chatbots. The design helps describe real-life behaviour without modifying or influencing it.

The study examines three major aspects:

1. Chatbot Memory – How chatbots forget past conversations and how features like AI memory or system integration can improve this.
2. Chatbot Security – User concerns about phishing, data privacy, and the effectiveness of security solutions such as digital IDs and real-time link checking.
3. Complex Query Handling – How satisfied users are when chatbots try to answer difficult or uncommon questions.

3.2 Sample Design

The sample design explains participant selection, sample size, and the area of data collection. The study uses both survey responses and chatbot interaction data.

Primary data was collected using online questionnaires shared with users who have experience using e-commerce chatbots. Secondary data was taken from journals, reports, and online sources to support the study.

3.2.1 Sampling Technique

The study uses a purposive sampling technique to include only individuals who have previously interacted with e-commerce chatbots. This ensures that responses come from people who can share meaningful opinions on chatbot memory, security, and handling of complex queries.

3.2.2 Sample Size

The study uses two sets of data:

- 160 respondents participated in the Google Form survey. This sample size is adequate for descriptive analysis and includes users from various demographic groups across India.
- 70 participants interacted with a custom-built chatbot. Their interactions helped measure real-time chatbot performance such as memory recall, security awareness, and complex query handling.

3.2.3 Area of Study

The study covers e-commerce users from different parts of India, ensuring a wide variety of backgrounds and shopping behaviours.

3.2.4 Period of Study

Data collection was carried out from September to November 2025.

3.3 Sources of Data

The study uses a combination of primary data and secondary data.

3.3.1 Primary Data

Primary data was gathered in two ways:

1. Google Form Survey

- Distributed to users who have previously interacted with chatbots.
- A total of 160 responses were collected.
- Questions focused on chatbot memory, security concerns, and satisfaction with complex query handling.

2. Chatbot Interaction Data

- A custom chatbot prototype was developed using the Landbot platform for this research.
- 70 users interacted with it directly.

- The chatbot automatically recorded data on user satisfaction, query resolution, memory response, and perceived security.

3.3.2 Secondary Data

Secondary data was collected from:

- Research papers and journal articles
- Reliable online resources

3.4 Instrument Development

A structured questionnaire was designed with four sections:

1. Demographics – Age, gender, location, and frequency of online shopping.
2. Chatbot Memory Performance – Questions on how well chatbots remember past conversations and possible improvements such as AI memory or CRM integration.
3. Security Perception – Questions on phishing awareness, trust in chatbots, and opinions on security features like digital IDs and real-time link checks.
4. Complex Query Handling – Questions measuring user satisfaction when chatbots handle difficult or unusual queries.

3.5 Analytical Tools

The collected data was analysed using basic statistical techniques, including:

- Percentage Analysis
- Chi-Square (χ^2) Test
- Frequency Distribution

Visual tools such as bar graphs, pie charts, and tables were used to present the findings clearly.

3.5.1 Software Used

- Microsoft Excel – For data analysis and chart preparation
- Landbot Chatbot Prototype – To collect real-time interaction data

CHAPTER - 4



DATA ANALYSIS & INTERPRETATION

4. DATA ANALYSIS AND INTERPRETATION

This chapter presents the findings from the 160 survey responses and 70 chatbot interactions collected using the Landbot platform. The study examines chatbot security, memory performance, and the ability to respond to complex queries. It also studies the age, gender, and behaviour of users to understand how people use chatbots. The chatbot-interaction data provides insights into real-time user behaviour and supports the survey findings.

4.1 Hypothesis Testing

Hypothesis testing is used to examine whether the assumptions made from the data are statistically significant. It includes making two types of statements — the null hypothesis (which says there is no difference or effect) and the alternative hypothesis (which says there is a difference or effect).

In this study, hypothesis testing is used to check users' views about chatbot security, memory, how well chatbots handle difficult questions, and overall satisfaction. Since most of the data is in categories, the Chi-Square Test is used to find out if there is a real connection between user responses and expected results. The test is conducted at a 5% significance level ($\alpha = 0.05$) to assess statistical significance.

The Chi-Square (χ^2) Test was used for all hypotheses in this study. The Chi-Square test is suitable for categorical data (e.g., Yes/No responses or ratings) and compares observed frequencies (O) with expected frequencies (E) to assess whether deviations from expectations are statistically significant.

Formula Used:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where:

- χ^2 (Chi-Square) = Test statistic
- O (Observed frequency) = Actual number of respondents in each category
- E (Expected frequency) = Number of respondents expected in each category under the null hypothesis

Decision Rule:

- Degrees of freedom (df) = Number of categories − 1
- Critical value for $\alpha = 0.05$ was used to determine significance.
    - If $\chi^2 >$ critical value, H_0 (null hypothesis) is rejected → statistically significant difference exists.
    - If $\chi^2 \leq$ critical value, H_0 is not rejected → no statistically significant difference exists.

Full Form of Key Terms Used:

- H_0 = Null Hypothesis
- H_1 / H_a = Alternative Hypothesis
- df = Degrees of Freedom
- α (Alpha) = Level of Significance
- χ^2 = Chi-Square Test Statistic
- O = Observed Frequency
- E = Expected Frequency

This method was applied to examine:

1. User concerns about chatbot security and privacy
2. User dissatisfaction with chatbot memory performance
3. Chatbot handling of complex queries

A) Based On Google Form Survey

Hypothesis 1: Chatbot Security and Privacy Concerns

Objective:

To examine whether users show significant concern regarding the security and privacy of e-commerce chatbots.

Hypotheses:

- **H_{01}:** There is no significant concern among users regarding chatbot security and data privacy.
- **H_{11}:** There is significant concern among users regarding chatbot security and data privacy.

Data Reference:

(Table 4.4.1 – Sharing of Sensitive Information)

Response	No. of Respondents	Percentage
Yes	58	36.3%
No	102	63.7%
Total	160	100%

Expected frequency (E): 80 for each group (equal distribution assumption).

$$\chi^2 = \frac{(58-80)^2}{80} + \frac{(102-80)^2}{80} = 12.1$$

df = 1

Critical value (α=0.05) = 3.841

Decision: 12.1 > 3.841 → **Reject H_{01}**

Interpretation:

The results indicate a statistically significant concern among users about chatbot data privacy and security. A majority of respondents are reluctant to share sensitive information, suggesting that trust and transparency in chatbot systems remain insufficient.

Inference:

E-commerce organizations must enhance encryption standards, data handling transparency, and user consent mechanisms to mitigate privacy apprehensions and foster greater trust in chatbot interactions.

Hypothesis 2: Chatbot Memory Performance and User Dissatisfaction

Objective:

To analyse whether users are dissatisfied with chatbot memory performance and contextual recall.

Hypotheses:

- **H_{02}:** There is no significant dissatisfaction among users regarding chatbot memory performance.
- **H_{12}:** There is significant dissatisfaction among users regarding chatbot memory performance.

Data Reference:

(Table 4.5.1 – Chatbot Forgetting Past Conversations)

Response	**Frequency**	**Percentage**
Yes	95	59.4%
No	65	40.6%
Total	160	100%

Expected frequency (E): 80 for each.

$$\chi^2 = \frac{(95-80)^2}{80} + \frac{(65-80)^2}{80} = 5.625$$

df = 1, **Critical = 3.841**

Decision: 5.625 > 3.841 → **Reject H_{02}**

Interpretation:

There is a significant dissatisfaction among users regarding chatbot memory functions. Over 59% of users report that chatbots forget previous conversations, while nearly half expressed frustration due to poor memory performance.

Inference:

To improve user experience, chatbots must integrate AI-based contextual memory, session history, and CRM integration to deliver more personalized and continuous interactions.

Hypothesis 3: Handling of Complex User Queries

Objective:

To determine whether chatbots can effectively handle complex user queries without human intervention.

Hypotheses:

- **H_{03}:** Chatbots can handle complex user queries effectively and independently.
- **H_{13}:** Chatbots cannot handle complex user queries effectively and require human assistance.

Data Reference:

(Table 4.6.3 – Human Assistance Preference)

Preference	No. of Respondents	Percentage
Yes (Prefer human help)	123	76.9%
No (Rely on chatbots)	37	23.1%
Total	160	100%

Expected frequency (E): 80 per category.

$$\chi^2 = \frac{(123 - 80)^2}{80} + \frac{(37 - 80)^2}{80} = 46.0$$

df = 1, **Critical = 3.841**

Decision: 46.0 > 3.841 → **Reject H_{03}**

Interpretation:

There is a significant gap in chatbot capability for managing complex queries. Most respondents still depend on human agents for problem resolution.

Inference:

To reduce human dependency, chatbots must be enhanced with advanced natural language understanding (NLU) and adaptive learning algorithms to improve comprehension of contextually complex or emotionally nuanced queries.

4.2 Demographic Profile of Respondents

4.2.1 Age Group

Particulars	No. of respondents	Percentage of respondents
18–25	108	67.5%
26–35	45	28.1%
36–45	6	3.8%
Above 46	1	0.6%
Total	**160**	**100%**

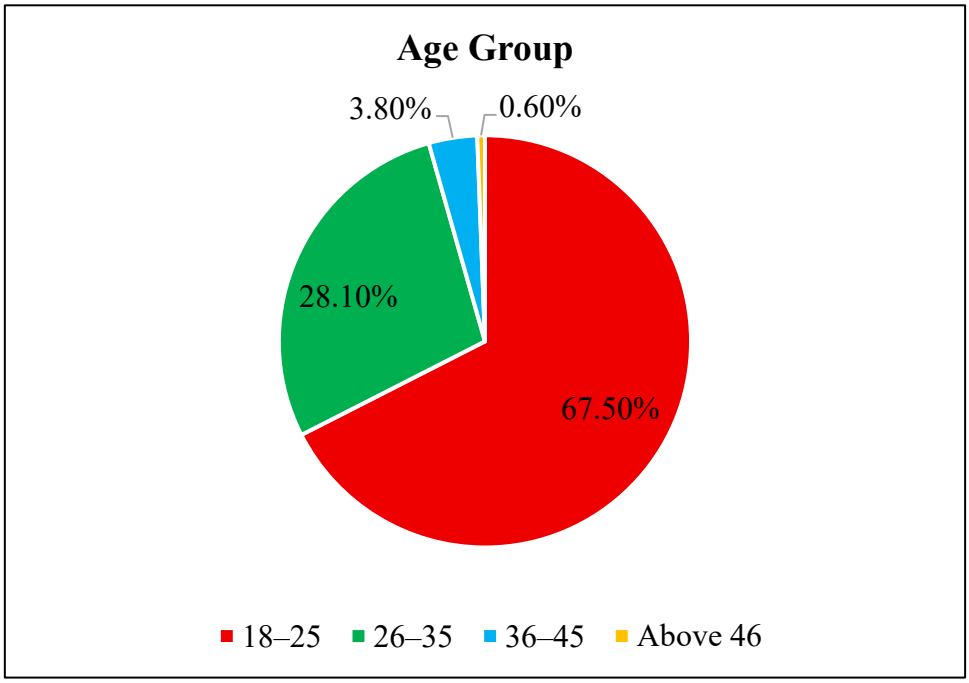


Fig: Chart 4.2.1 Age Group of Respondents

Interpretation:

From the above data, a total of 160 respondents participated in the study. Among them, 108 respondents (67.5%) belong to the age group of 18–25, 45 respondents (28.1%) are between 26–35, 6 respondents (3.8%) are between 36–45, and 1 respondent (0.6%) is above 46 years of age.

Inference:

The majority of respondents are between the age group of 18–25 years.

4.2.2 Gender Profile

Particulars	No. of respondents	Percentage of respondents
Male	89	55.6%
Female	71	44.4%
Total	**160**	**100%**

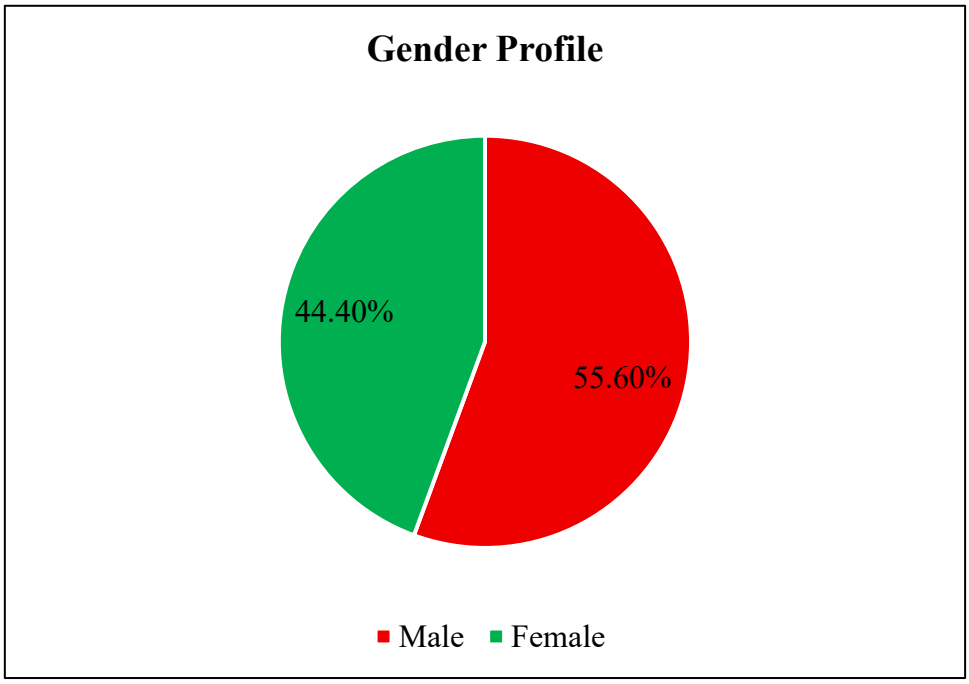


Fig: Chart 4.2.2 Gender Profile of Respondents

Interpretation:

From the above data, out of 160 respondents, 89 (55.6%) are male and 71 (44.4%) are female.

Inference:

The majority of the respondents in this study are male.

4.2.3 Occupation of Respondents

Particulars	No. of respondents	Percentage of respondents
Students	79	49.4%
Employed	62	38.8%
Unemployed	16	10%
Others	3	1.8%
Total	**160**	**100%**

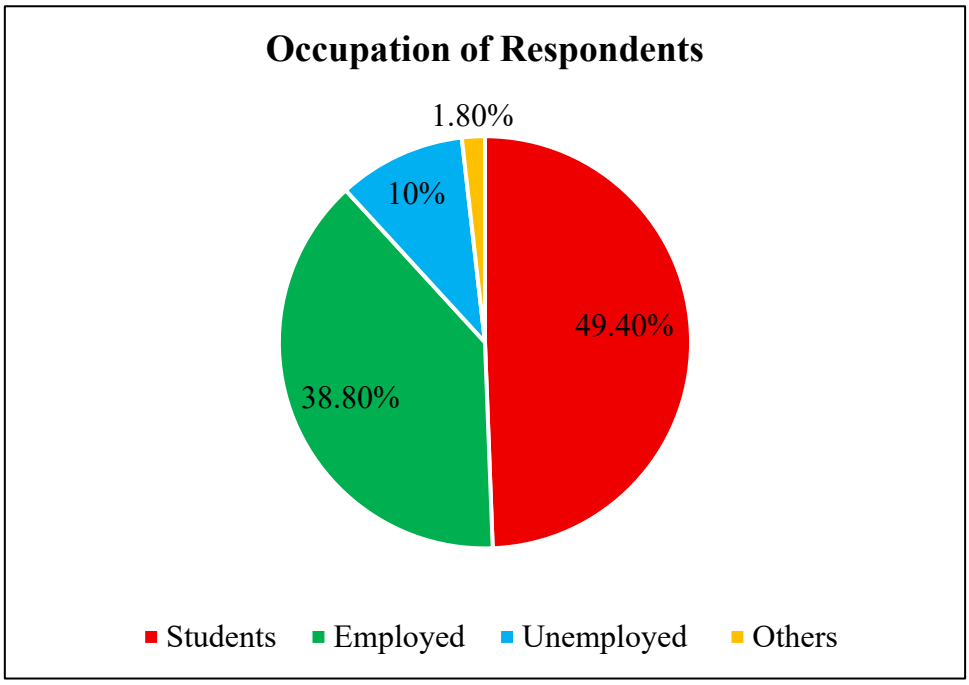


Fig: Chart 4.2.3 Occupation of Respondents

Interpretation:

The data shows that 79 respondents (49.4%) are students, 62 (38.8%) are employed, 16 (10%) are unemployed, and 3 (1.8%) belong to other categories.

Inference:

The majority of the respondents are students, followed by employed individuals. This indicates that students and working professionals are the primary users engaging with e-commerce chatbots, possibly due to their higher exposure to digital platforms and online shopping activities.

4.3 Experience with Chatbots

4.3.1 Interaction with Chatbots

Particulars	No. of respondents	Percentage of respondents
Yes	126	78.8%
No	25	15.6%
Maybe	9	5.6%
Total	**160**	**100%**

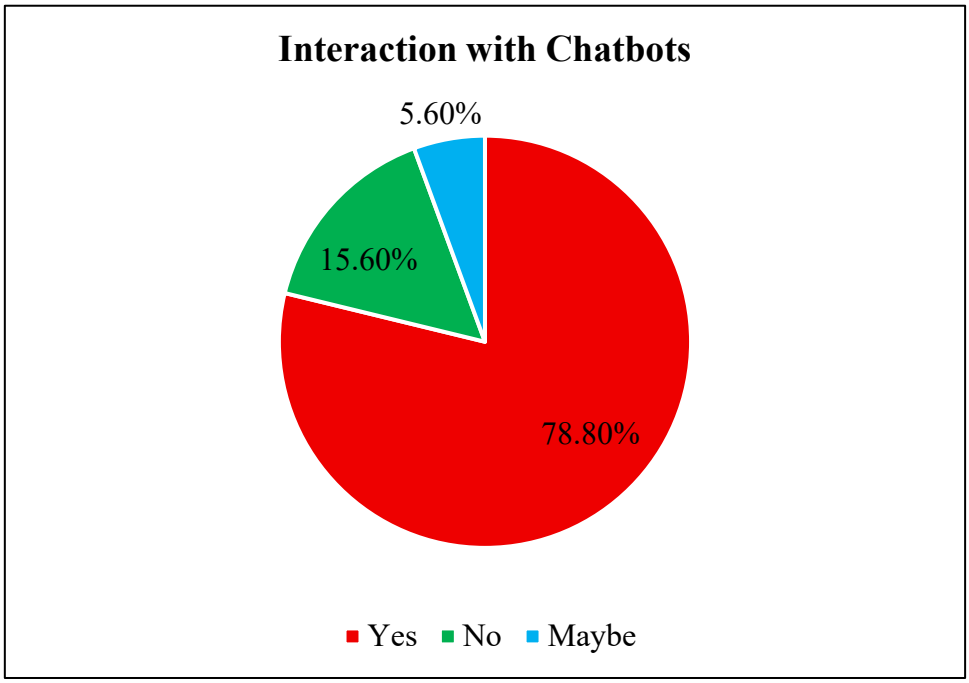


Fig: Chart 4.3.1 Interaction with Chatbots

Interpretation:

The data shows that 126 respondents (78.8%) have experience using chatbots, 25 respondents (15.6%) have not used chatbots, and 9 respondents (5.6%) are unsure about their experience.

Inference:

The majority of respondents have interacted with chatbots, indicating a high level of familiarity and exposure to chatbot technology. This suggests that chatbot usage is becoming increasingly common among users, reflecting growing acceptance and integration of AI-based customer support tools in e-commerce platforms.

4.4 Chatbot Security Analysis

4.4.1 Sharing of Sensitive Information

Particulars	No. of respondents	Percentage of respondents
Yes	58	36.3%
No	102	63.7%
Total	**160**	**100%**

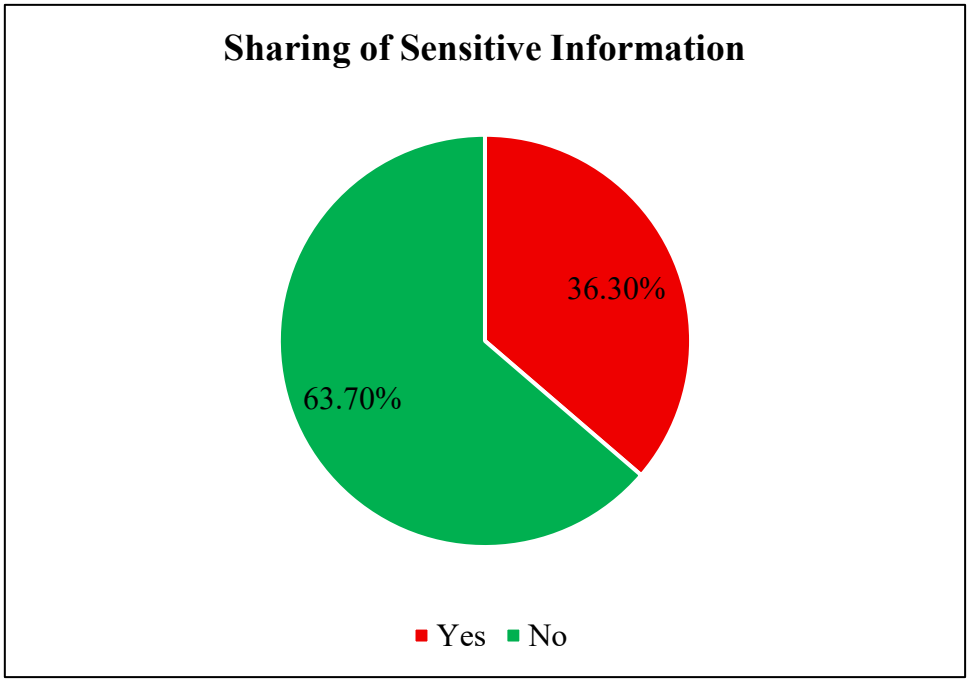


Fig: Chart 4.4.1 Sharing of Sensitive Information

Interpretation:

The data shows that 58 respondents (36.3%) are willing to share sensitive information with chatbots, while 102 respondents (63.7%) are not comfortable sharing such information.

Inference:

The majority of respondents are reluctant to share sensitive information with chatbots, indicating concerns about privacy and data security. This suggests that trust and transparency in chatbot interactions remain key challenges for e-commerce platforms seeking to enhance user confidence in AI-driven systems.

4.4.2 Concern About Phishing Attacks

Level of Concern	No. of Respondents	Percentage
1 (Not concerned)	16	10%
2	22	13.8%
3	59	36.9%
4	43	26.9%
5 (Extremely concerned)	20	12.5%
Total	**160**	**100%**

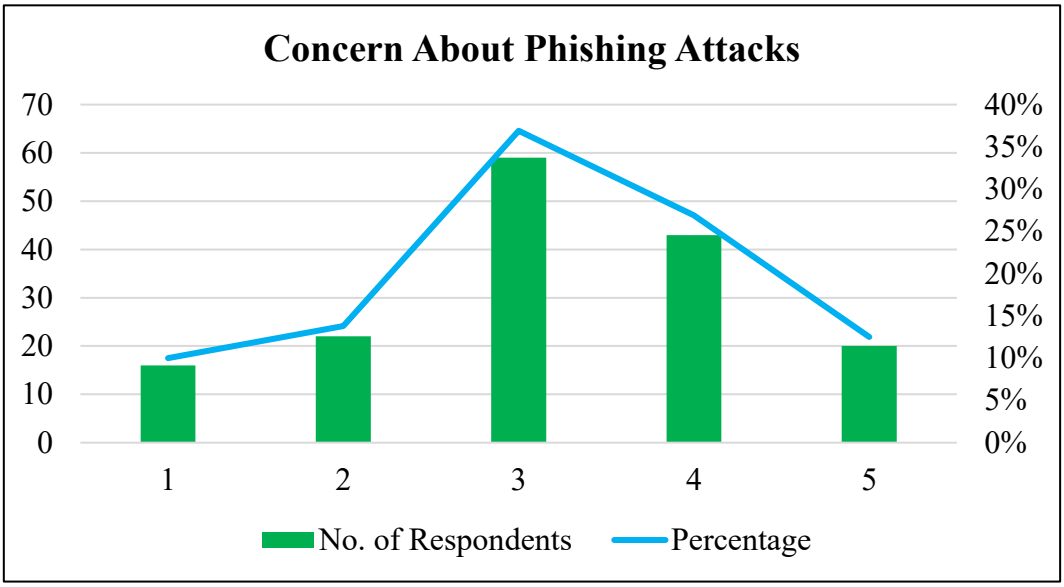


Fig: Chart 4.4.2 Concern About Phishing Attacks

Interpretation:

The data shows that 59 respondents (36.9%) have a moderate level of concern about phishing attacks, while 63 respondents (39.4%) expressed high to extreme concern (levels 4 and 5). Meanwhile, 38 respondents (23.8%) showed low concern (levels 1 and 2).

Inference:

The majority of respondents demonstrate at least a moderate level of concern toward phishing attacks, indicating growing awareness about online security threats. However, the presence of some respondents with low concern suggests that continuous education and awareness programs are needed to strengthen cybersecurity consciousness among users.

4.4.3 Effectiveness of Security Solutions

Effectiveness Rating	Digital IDs for Verification	Real-time Link Checking	AI-based Fraud Detection
1	23	15	16
2	30	26	22
3	36	46	42
4	43	41	45
5	26	28	33

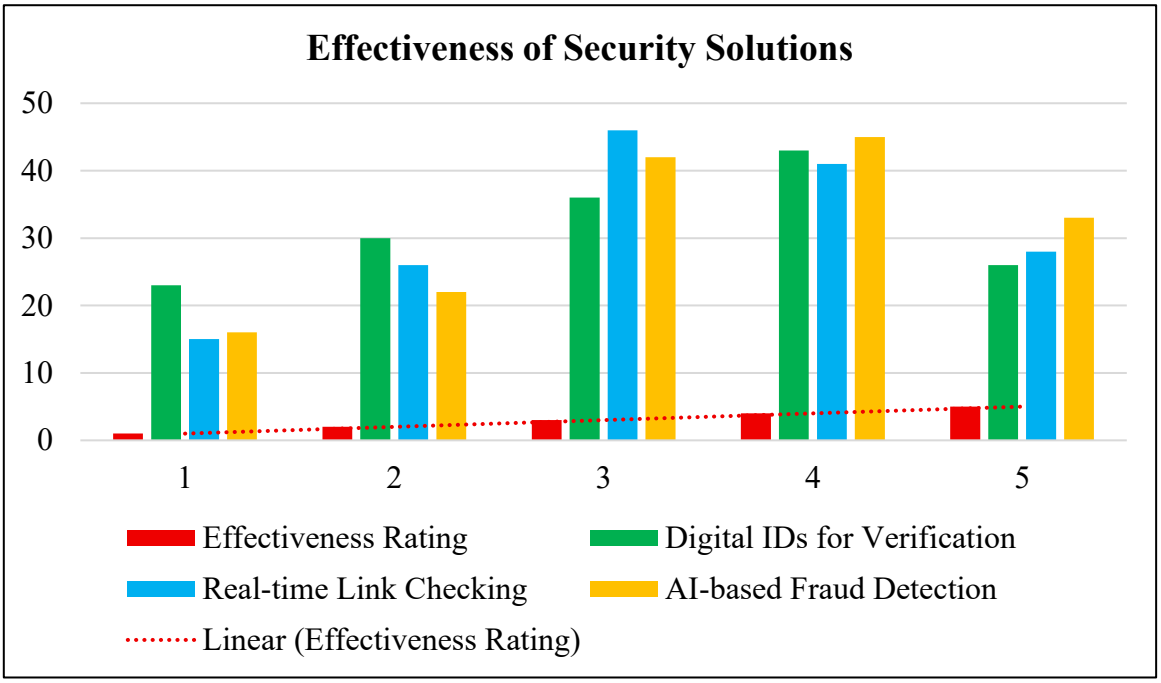


Fig: Chart 4.4.3 Concern About Phishing Attacks

Interpretation:

The data shows that for Digital IDs for Verification, 43 respondents rated effectiveness level 4 (highest count), indicating a strong belief in its reliability. For Real-time Link Checking, 46 respondents rated it at level 3, suggesting moderate perceived effectiveness. Meanwhile, AI-based Fraud Detection received the highest ratings overall, with 45 respondents rating it at level 4 and 33 at level 5, showing greater confidence in its capability.

Inference:

Among the three security solutions, AI-based Fraud Detection is perceived as the most effective by respondents, followed by Digital IDs for Verification, while Real-time Link Checking is seen as moderately effective. This suggests that users have more trust in advanced, AI-driven security technologies for detecting and preventing online fraud compared to traditional verification or link-checking methods.

4.5 Chatbot Memory Performance

4.5.1 Chatbot Forgetting Past Conversations

Particulars	No. of Respondents	Percentage
Yes	95	59.4%
No	65	40.6%
Total	**160**	**100%**

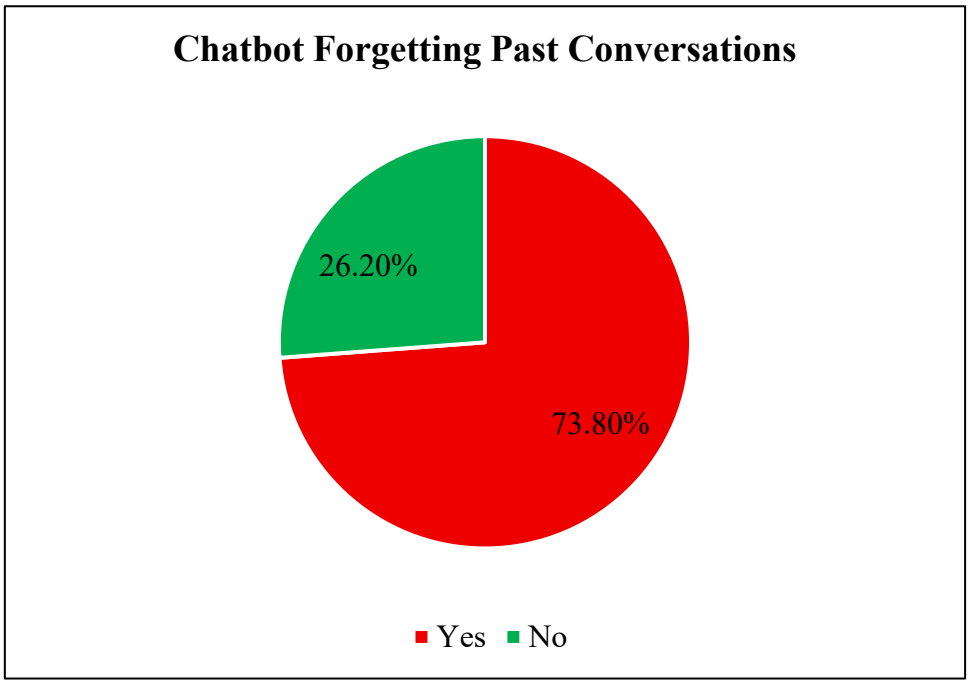


Fig: Chart 4.5.1 Chatbot Forgetting Past Conversations

Interpretation:

The data shows that 95 respondents (59.4%) stated that chatbots forget past conversations, while 65 respondents (40.6%) mentioned that chatbots remember previous interactions.

Inference:

A majority of respondents feel that chatbots fail to retain past conversations, indicating a gap in chatbot memory performance. This suggests that improving contextual memory and continuity in chatbot interactions could lead to more personalized and seamless user experiences in e-commerce platforms.

4.5.2 Frustration Due to Poor Memory

Level of Frustration	No. of Respondents	Percentage
1 (Not frustrating)	18	11.3%
2	16	10%
3	50	31.3%
4	36	22.4%
5 (Extremely frustrating)	40	25%
Total	**160**	**100%**

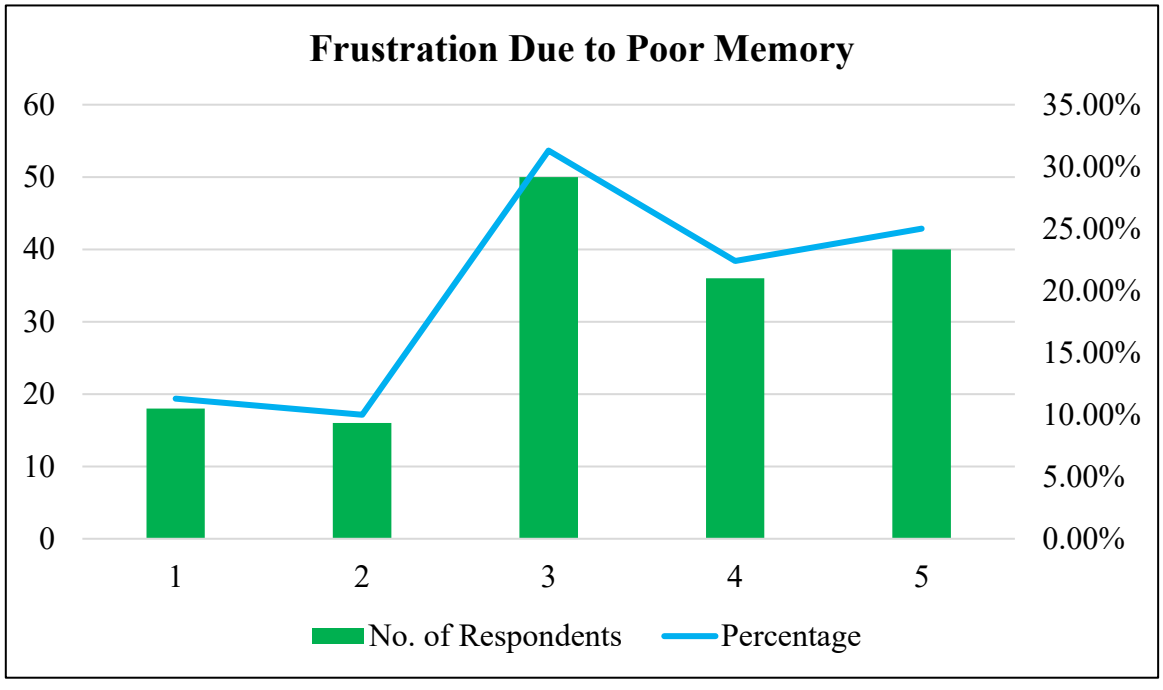


Fig: Chart 4.5.2 Frustration Due to Poor Memory

Interpretation:

The data shows that 50 respondents (31.3%) experienced a moderate level of frustration (level 3) due to poor chatbot memory, while 76 respondents (47.4%) reported high to extreme frustration levels (levels 4 and 5). In contrast, 34 respondents (21.3%) indicated low frustration levels (levels 1 and 2).

Inference:

The majority of respondents expressed moderate to high frustration with chatbots' poor memory, suggesting that memory limitations significantly impact user satisfaction. This indicates a need for improved chatbot design with better memory retention and contextual understanding to reduce user frustration and enhance overall interaction quality.

4.5.3 Suggested Memory Improvements

Suggested Feature	No. of Respondents	Percentage
AI-based memory	92	57.5%
CRM integration	63	39.4%
User session history	72	45%

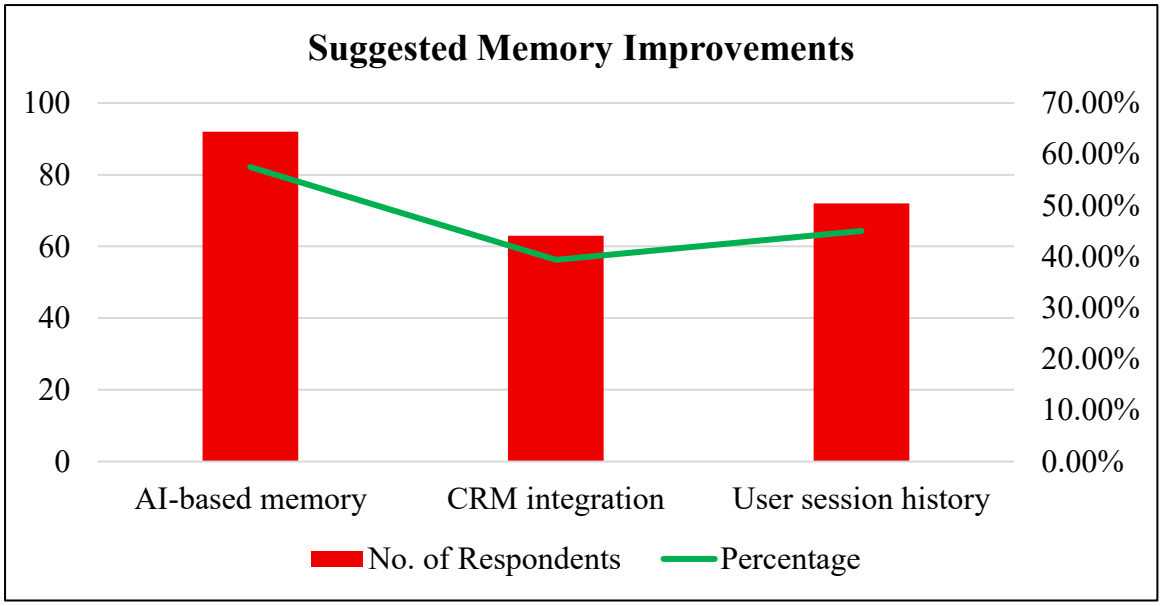


Fig: Chart 4.5.3 Suggested Memory Improvements

Interpretation:

The data shows that 92 respondents (57.5%) suggested implementing AI-based memory to improve chatbot performance, while 72 respondents (45%) recommended adding user session history. Additionally, 63 respondents (39.4%) proposed CRM integration to enhance personalization and continuity in chatbot interactions.

Inference:

Most respondents favour AI-based memory as the most effective improvement for enhancing chatbot memory performance. This indicates a strong preference for intelligent, adaptive systems that can recall user interactions and provide personalized responses, supported by features like session history and CRM integration for better customer engagement and satisfaction.

4.6 Handling of Complex User Queries

4.6.1 Success in Handling Complex Queries

Frequency	No. of Respondents	Percentage
Always	26	16.3%
Often	42	26.3%
Sometimes	65	40.6%
Rarely	22	13.7%
Never	5	3.1%
Total	**160**	**100%**

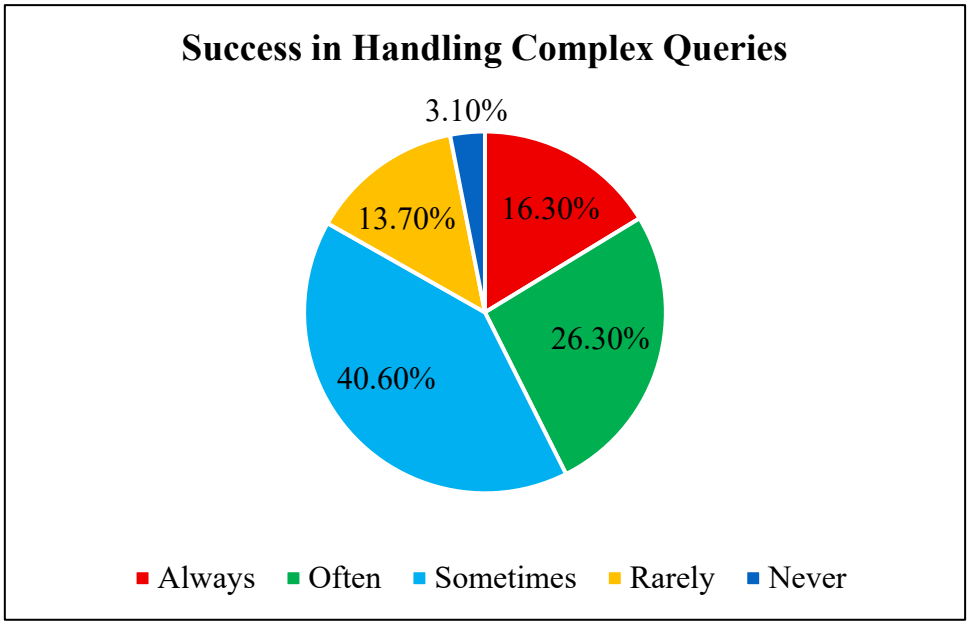


Fig: Chart 4.6.1 Success in Handling Complex Queries

Interpretation:

The data shows that 65 respondents (40.6%) stated that chatbots sometimes handle complex queries successfully, while 68 respondents (42.6%) indicated that chatbots often or always succeed (levels "Often" and "Always" combined). Meanwhile, 27 respondents (16.8%) reported that chatbots rarely or never manage complex queries effectively.

Inference:

The majority of respondents believe that chatbots perform moderately well in handling complex queries, suggesting that while they are capable to some extent, there is still room for improvement. Enhancing chatbot algorithms with better natural language understanding and problem-solving abilities could lead to higher accuracy and consistency in addressing complex customer issues.

4.6.2 Satisfaction with Query Handling

Level of Satisfaction	No. of Respondents	Percentage
1 (Very Dissatisfied)	15	9.4%
2	15	9.4%
3	67	41.9%
4	48	30%
5 (Very Satisfied)	15	9.4%
Total	**160**	**100%**

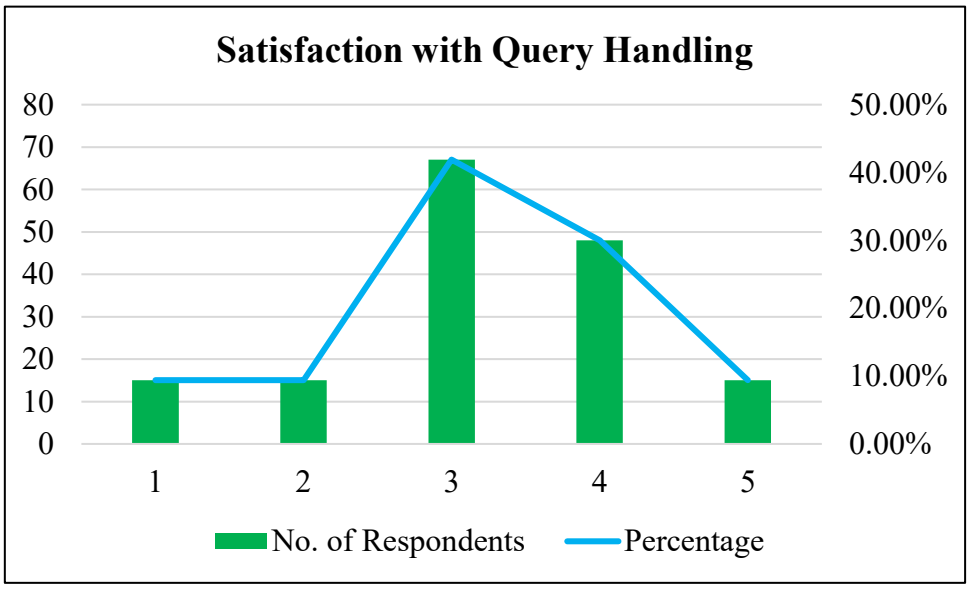


Fig: Chart 4.6.2 Satisfaction with Query Handling

Interpretation:

The data shows that 67 respondents (41.9%) expressed a moderate level of satisfaction (level 3) with chatbot query handling, while 63 respondents (39.4%) reported being satisfied or very satisfied (levels 4 and 5 combined). Meanwhile, 30 respondents (18.8%) indicated dissatisfaction (levels 1 and 2).

Inference:

Most respondents are moderately satisfied with the chatbot's ability to handle queries, indicating that while chatbots meet basic expectations, there is still potential for improvement. Enhancing chatbot responsiveness, accuracy, and personalization could further increase user satisfaction and trust in automated customer service systems.

4.6.3 Human Assistance Preference

Particulars	No. of Respondents	Percentage
Yes	123	76.9%
No	37	23.1%
Total	**160**	**100%**

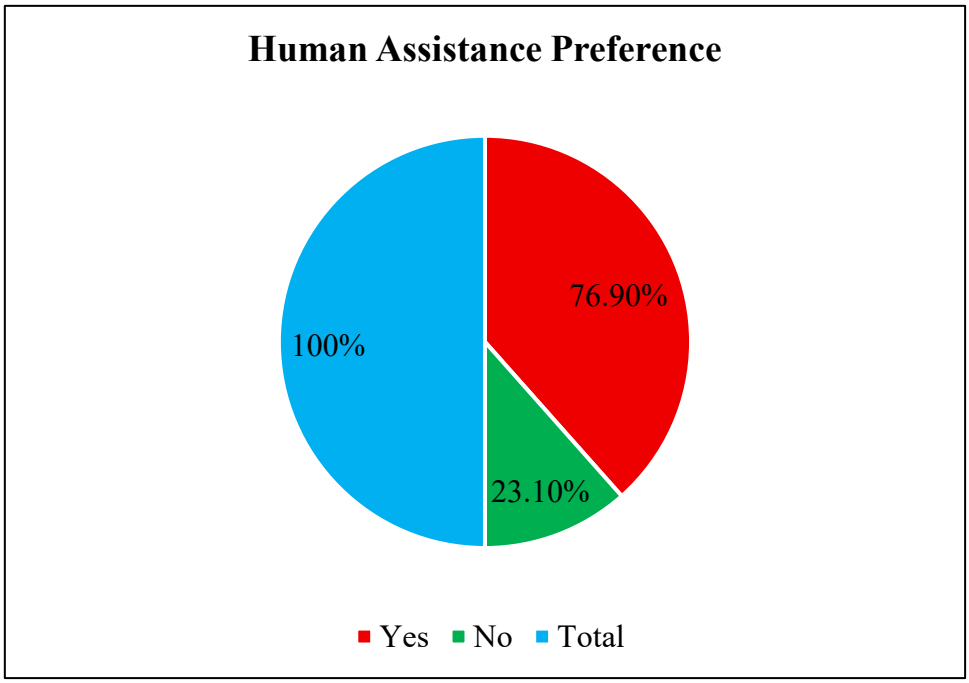


Fig: Chart 4.6.3 Human Assistance Preference

Interpretation:

The data shows that 123 respondents (76.9%) prefer human assistance over chatbots for resolving their queries, while only 37 respondents (23.1%) are comfortable relying solely on chatbots.

Inference:

A large majority of respondents still prefer human interaction when dealing with complex or important issues, indicating that chatbots have not yet achieved full user trust or reliability. This suggests the need for a hybrid support model where chatbots handle basic queries efficiently, while human agents assist with more nuanced or complex concerns to improve overall customer satisfaction.

B) Based On Chatbot Interaction

4.7 Chatbot Memory Performance (Based on Repeated Queries)

Particulars	No. of Occurrences	Percentage
Unique Queries (First-time interactions)	49	70%
Repeated Queries (User asking same type again)	21	30%
Total	**70**	**100%**

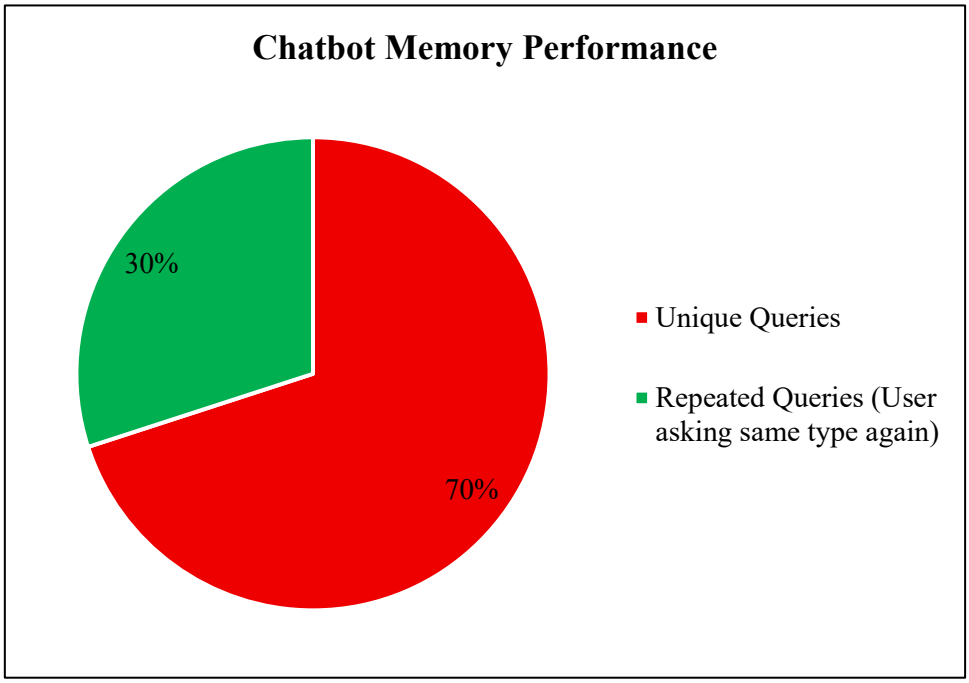


Fig: Chart 4.7. Chatbot Memory Performance (Based on Repeated Queries)

Interpretation:

The analysis shows that 30% of questions are asked again, which means chatbots cannot remember previous conversations well. This shows that their memory and understanding of context are weak, and users have to repeat the same problems. This makes people less satisfied and trust the chatbot less.

Inference:

Right now, chatbots cannot remember past chats properly, which affects the user experience. If we add memory that understands context and tracks sessions, it can reduce repeated questions and make users happier.

4.8 Average Interaction Time By Query Type

Query Type	Query	Interaction Time (Sec)
Simple	Track Order, Return Product	30
Moderate	Update Address, Request Invoice	48
Complex	Unauthorized Transaction, Payment Failure	73

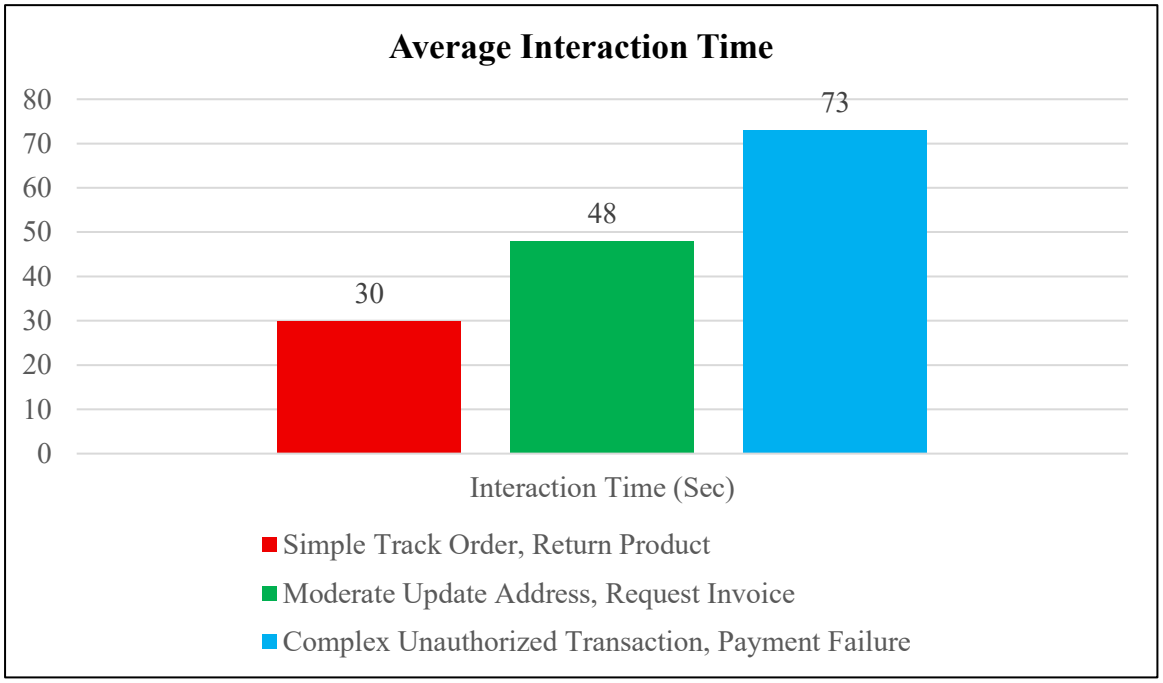


Fig: Chart 4.8 Average Interaction Time by Query Type

Interpretation:

The time users spend interacting with the chatbot goes up as questions get more complicated. Simple questions are answered quickly, but complex ones take longer, showing that the chatbot struggles with detailed or multi-step problems.

Inference:

Chatbots work well for easy and routine questions but have trouble with complex ones. Using better language understanding and linking multiple steps could help the chatbot answer complicated questions faster and more correctly.

CHAPTER - 5



FINDINGS & SUGGESTIONS

5. FINDINGS & SUGGESTIONS

This part gives a summary of the main findings from the data analysis and hypothesis testing done earlier. The results are explained based on the study's goals — focusing on chatbot security, memory performance, ability to handle difficult questions, and overall user satisfaction in e-commerce.

The study collected answers from 160 participants using a structured questionnaire. Simple statistical tools like percentage analysis and the Chi-Square test were used to find important connections and understand user opinions.

The results from this study help to give practical ideas and suggestions for improving chatbot features, increasing user trust, and encouraging more people to use chatbots in online businesses.

5.1 Major Findings

➢ **Findings Related to Chatbot Security**

a) User Reluctance to Share Sensitive Data:

- 63.7% of respondents reported that they are unwilling to share sensitive or financial information with chatbots.
- This indicates persistent trust and privacy concerns despite the widespread use of chatbots in e-commerce.

b) Fear of Phishing Attacks:

- Nearly 64% of respondents reported moderate to extreme concern about phishing attempts, indicating a growing awareness of online threats.

c) Preference for AI-based Security Systems:

- While all three solutions—Digital ID Verification, Real-Time Link Checking, and AI-based Fraud Detection—were rated positively, AI-based systems received the highest confidence scores.
- This demonstrates user preference for intelligent, automated fraud prevention mechanisms.

d) Need for Data Transparency:

- Respondents emphasized that they lack clarity on how their data is stored and used, suggesting a need for greater transparency in chatbot data policies.

➢ **Findings Related to Chatbot Memory Performance**

a) Inability to Retain Contextual Data:

- 59.4% of respondents indicated that chatbots forget past conversations, while only 40.6% experienced consistent memory retention.
- This reflects a major limitation in chatbot design—its inability to maintain continuity during interactions.

b) High Frustration Among Users:

- 47.4% of participants expressed high or extreme frustration with chatbots due to poor memory performance, while only 21.3% reported low frustration.
- This suggests that memory limitations directly affect user satisfaction.

c) Preferred Solutions for Improvement:

- Respondents strongly recommended the adoption of:
    - **AI-based memory algorithms (57.5%)**
    - **User session history storage (45%)**
    - **CRM integration (39.4%)**
- These features would help chatbots retain previous user interactions and offer more personalized experiences.

d) Implication for Design:

- The findings indicate a demand for context-aware, intelligent chatbots capable of learning from past interactions and adapting their responses over time.

➢ **Findings Related to Handling of Complex Queries**

a) Moderate Efficiency in Complex Query Resolution:

- Only 42.6% of respondents agreed that chatbots can often or always handle complex queries effectively, while 16.8% believed chatbots rarely or never succeed.
- This suggests chatbots perform reasonably well for routine queries, but struggle with multifaceted or emotional inquiries.

b) Strong Preference for Human Assistance:

- 76.9% of respondents stated they prefer human support over chatbots when dealing with complex issues.
- This indicates a continued reliance on human expertise for problem-solving and decision-making.

c) Nature of Complex Queries:

- Respondents noted that chatbots often fail when queries involve multiple product options, refund disputes, or emotional complaints.
- The limitations arise primarily from insufficient contextual understanding and sentiment analysis.

5.2 Suggestions

1. Improving Security and Privacy

To keep customer data safe, e-commerce websites should use strong security systems like encryption and two-step login. Using AI tools to catch scams and fake links can stop hacking and fraud. Businesses should also clearly explain how they use and protect customer data. Showing trust badges or privacy certificates can help users feel safer when chatting with chatbots.

2. Making Chatbots Remember Better

Chatbots should be able to remember what users said before to give more personal replies. Using AI memory and connecting chatbots with customer databases can help them continue conversations without repeating questions. This makes chatting easier and more satisfying for users.

3. Handling Difficult Questions

To answer complex questions, chatbots should use better language and learning technology. If a chatbot doesn't understand something, it should quickly connect the user to a real person. Training chatbots regularly using real customer chats can help them learn and improve over time.

5.3 Future Scope

1. Enhanced Security Infrastructure

In the future, chatbots can be made safer by using better security tools. These include AI systems that can quickly detect fraud, warn users about fake links, and protect personal information. More transparent data policies can also help users understand how their information is being used, which will increase trust.

2. Advanced Memory and Context Management

Chatbots can be improved by giving them a better memory system. Future chatbots can remember past conversations, understand user preferences, and continue a chat without repeating questions. Using AI-based memory and connecting chatbots with customer databases can help create more personalized and smooth conversations.

3. Improved Handling of Complex Queries

In the future, chatbots can be made smarter so they can solve difficult or multi-step questions more accurately. New technologies like advanced language models and emotion detection can help chatbots understand complicated requests. A mix of chatbot help and quick human support can also improve the overall experience.

6. CONCLUSION

The study titled **"A Study on E-Commerce Chatbot Security, Memory Performance, and Handling of Complex User Queries for Consumer Satisfaction"** was done to understand how well chatbots work in online shopping, especially in terms of their security, memory, and ability to answer difficult questions.

From the responses of 160 participants, it was found that even though chatbots are now an important part of online customer service, many users still have concerns that affect their trust and satisfaction.

Most users said that chatbots are useful for giving quick answers and 24/7 support. However, they also shared worries about data privacy, scams like phishing, and the fact that chatbots often forget past conversations. Many users felt that chatbots do not always understand context, which makes the experience repetitive and sometimes frustrating.

The study also found that chatbots are good at handling simple or common questions, but they are not as effective when it comes to complex or emotional issues. In such cases, users still prefer talking to a real person. The statistical tests supported these findings, showing that users were not fully satisfied with chatbot security, memory, and their ability to handle complex questions. Overall, user satisfaction was found to be moderate — meaning that while chatbots do their basic job, they still lack the human touch that people expect.

Even with these issues, users showed strong trust in AI-based safety tools like fraud detection systems, showing that people are becoming more open to using artificial intelligence for secure and smart customer service.

To make chatbots better in the future, the study suggests that businesses should:

- Improve data security and be more transparent with users,
- Add AI-based memory systems to make chats more personal,
- Develop better natural language and empathy features, and
- Use a mix of chatbots and human support for better customer experiences.

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ANNEXURE

Questionnaire

1. Name: _____

2. Age Group:

☐ 18–25 ☐ 26–35 ☐ 36–45 ☐ Above 46

3. Gender:

☐ Male ☐ Female ☐ Prefer not to say

4. What is your current occupation?

☐ Student ☐ Employed ☐ Unemployed ☐ Other: _____

5. Have you ever interacted with a chatbot on an e-commerce or service website?

☐ Yes ☐ No ☐ Maybe

6. Have you ever been asked by a chatbot to share sensitive information (e.g., OTP, password, payment details)?

☐ Yes ☐ No

7. If yes, what action did you take?

☐ Shared the information ☐ Ignored the request ☐ Reported the issue ☐ Other

8. How concerned are you about phishing attacks through chatbots?

(1 = Not concerned, 5 = Extremely concerned)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

9. How effective do you think the following solutions are in preventing phishing?

Solutions	1	2	3	4	5
Digital IDs for verification	☐	☐	☐	☐	☐
Real-time link checking	☐	☐	☐	☐	☐
AI-based fraud detection	☐	☐	☐	☐	☐

10. Share any experience or suggestions regarding chatbot security:

11. Have you noticed a chatbot forgetting your previous conversations or context?

☐ Yes ☐ No

12. How frustrating is it when a chatbot cannot remember past interactions?

(1 = Not frustrating, 5 = Extremely frustrating)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

13. Which of the following improvements would make chatbot memory better?

☐ AI-based memory

☐ Integration with CRM systems

☐ User account-based session history

☐ Other: _____

14. Please describe any situation where a chatbot's memory limitation affected your experience:

15. How often does a chatbot successfully answer your complex or uncommon queries?

☐ Always ☐ Often ☐ Sometimes ☐ Rarely ☐ Never

16. How satisfied are you with chatbots handling your queries?

(1 = Very dissatisfied, 5 = Very satisfied)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

17. What could improve chatbot performance in addressing complex queries?

18. Would you prefer interacting with a human if a chatbot fails to answer your query?

☐ Yes ☐ No

19. Overall, how would you rate your experience with chatbots?

(1 = Very poor, 5 = Excellent)

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5