Usability and Accessibility Challenges of Integrating Augmented Reality into E-commerce for First-Time Users

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Abstract- ***Merger of Augmented Reality (AR) technologies with e-commerce functions has revolutionized web shopping by enabling customers to experience items realistically during purchasing processes. Through AR technology users can visualize products in their real environments thus they gain certainty and make better choices before buying anything. New users encounter substantial usability problems and accessibility issues which prevent them from conducting successful interactions with AR shopping platforms. The research analyzes these user obstacles to discover essential obstacles combined with appropriate solutions which boost user satisfaction. The research approach mixes methods by testing usability concerning user conversations and gathering survey responses specifically from new users who access e-commerce using AR. The usability testing sessions evaluated user interactions with AR features and recorded specific difficulties that users encountered during navigation as well as while using interfaces and managing task execution efficiency. The collection of survey responses together with interview data enabled researchers to understand user reactions while using AR shopping functions. The researchers analyzed their gathered data to establish the key difficulties and their influence on user engagement behavior. The use of AR for e-commerce faces three critical problems which affect novices during their initial interaction: excessive difficulty in navigation and challenging interface operations coupled with overwhelming mental workload. The usability suffers due to technical barriers which consist of hardware-device restrictions as well as software-performance problems and inconsistent internet connections. The accessibility barriers consist of limited assistance for users with disabilities and non-existent alternative interaction approaches along with deficient instructional directions. The multiple barriers create challenges during the shopping process that leads customers to use AR features less frequently. The analysis suggests that resolving both usability problems and accessibility issues will lead to a smooth and inclusive shopping experience when using augmented reality. First-time user adoption of AR technology improves through basic step-by-step tutorial guidance that pairs with user-friendly interface modifications and accessibility standards including screen reader capabilities and gesture control options. The resolution of usability and accessibility problems through e-commerce platforms allows them to maximize AR technology benefits resulting in enhanced user contentment alongside enhanced consumer participation and increased purchase conversion.***

I. INTRODUCTION

Background Information

Augmented Reality (AR) represents a groundbreaking technology for e-commerce that creates interactive immersive shopping options to connect physical and digital retail domains. The real-world visualization capabilities of AR enable customers to make better purchasing decisions since they can see products through their expected environments. Major e-commerce platforms now integrate AR features because mobile commerce and technological development has expanded together with customer engagement. The effective utilization of AR technology by new online shoppers remains restricted because of considerable ease of use and accessibility hurdles they encounter. Users encounter difficulties caused by both system technical restrictions and issues related to their interaction with the platform and mental workload management.

Improving digital shopping requires businesses to understand the particular struggles new users encounter when using AR technology in e-

commerce. The resolution of these problems will produce better user adoption results which will boost customer satisfaction expanding online retailer conversion rates. Research has primarily studied the benefits of AR but it has not provided enough examination of barriers which confront new users. The research aims to resolve this knowledge gap through the identification of essential usability and accessibility barriers while presenting possible answers for creating inclusive AR shopping systems.

II. LITERATURE REVIEW

The majority of studies focusing on AR in e-commerce demonstrate its capacity to engage customers better and reduce purchase-related uncertainties and enhance trust. Customer satisfaction rises when AR technology provides users with detailed investigation capabilities in a personalized interactive shopping environment. Retail-based AR applications as shown by Rese et al. (2017) deliver higher levels of usefulness and enjoyment that boost users' purchase intentions. The interactive elements of AR technology generate immersive effects that Javornik (2016) describes as making online shopping more exciting and interactive.

Very few researchers have investigated the problems faced by new users who use AR-based shopping interfaces. Users tend to resist adopting AR because of usability problems that produce confusing interfaces with poor navigation pathways. Users who face accessibility barriers due to disablities encounter exclusion from complete inclusion in AR shopping experiences because AR lacks suitable accommodations. The research extends previous studies by detailing the obstacles first users encounter while using AR-based shopping interfaces and suggesting specific solutions to address these problems.

Research Questions or Hypotheses

The research investigates the combined barriers of usability and accessibility which arise when implementing AR into e-commerce systems for people who use it for the first time. A set of research questions determines the study direction.

1. The primary obstacles to usability appear for novel users while interacting with AR-based e-commerce applications.
2. What obstacles hinder consumers with disabilities when they use AR applications for their shopping activities?
3. What impact do usability and accessibility problems generate when first-time users use the platform and decide to purchase?
4. New users would benefit from which design elements to improve the usability and accessibility of AR interactions.

The study base its hypotheses on these research questions.

Users who encounter AR for the first time will face multiple usability problems such as complicated navigation systems and an overload of information. AR-based e-commerce platforms become exclusionary when assistive features are missing from their offerings.

AR technology adoption rates in online shopping will rise after improving accessibility and usability characteristics.

Significance of the Study

This study delivers important knowledge which benefits both e-commerce organizations and AR developers and UX specialists who work on enhancing AR-based shopping interfaces. The study tackles usability and accessibility obstacles to generate solutions which can validate enhancements for AR interface development and user welcome methods. Enhanced usability of AR for e-commerce will increase its adoption rate while making the technology available to people with disabilities as well as other consumer groups.

The findings advance academic knowledge regarding AR usability by transforming academic exploration from benefits analysis to genuine user challenges. The obtained findings will support future work in AR system development and user experience creation and inclusive technology deployment research. The solution of these obstacles enables e-commerce businesses to enhance their AR applications while maintaining better customer loyalty and digital shopping interaction.

III. METHODOLOGY

Research Design

The investigation utilizes a mixed-methods approach for complete analysis related to usability and accessibility problems of first-time AR users in e-commerce systems. Multiple research methods used together create complete knowledge about how users perform along with their behavioral patterns and encountered difficulties. The research combines user interviews with observation-based usability testing as qualitative elements and surveys together with task performance metrics as quantitative aspects. The employed method provides researchers with detailed qualitative findings together with quantitative statistical proof of their statements.

Participants or Subjects
The research investigates new users who interact with mobile-AR-based e-commerce systems. Selection of participants occurs through specific criteria evaluation.

The participant group includes people who avoid using AR applications for online shopping.
The accessibility evaluation includes participants from various age groups together with people of both genders and disabled users to identify all accessibility challenges.

The study includes participants that possess any device suitable for AR functionality such as smartphones tablets or AR headsets.

This study has convened 50 participants who have been separated between two different test groups.

The general user group contains forty participants who experience AR shopping for the first time.

A group consisting of 10 participants using assistive technologies carried out the disability assessment to identify barriers about accessibility features.

Data Collection Methods
Different research methods help the study acquire complete understanding through its data collection process.

1.Usability Testing:
Participants who use AR features across an e-commerce website either see visualizations of products or attempt the virtual try-on functionality.
Eye-tracking technology in combination with screen recording functions monitor how participants navigate platforms and evaluates their interaction challenges and counting of errors.

The evaluation of usability efficiency occurs through tracking the completion durations combined with success achievement records.

2.Surveys:
Surveys administered before the test assess the participant demographics and their background usage of AR technology.

After the test users respond to Likert scale questions to indicate their evaluation regarding system usability along with their frustration and general product satisfaction.

3.Interviews:
After usability testing semi-structured interviews take place to gather participant feedback about their experiences along with their difficulties and recommendations for improvement.

Accessibility challenges particular to users with disabilities become the main focus of assessment.

Data Analysis Procedures

- Quantitative Data Analysis:

Statistical analysis such as descriptive statistics and correlation analysis helps to identify usability trends.

The evaluation of AR usability performance relies on three metrics: task success rates alongside error frequency data and task completion times.

Noise from the survey responses gets evaluated through mean scores and standard deviations to calculate user satisfaction results.

- Qualitative Data Analysis:

Thematic analysis of interview responses allows researchers to detect common usability and accessibility problems in the designated system.

The collected observational usability test data receives coding processes to reveal standard user challenges together with typical interaction methods.

Ethical Considerations

All participants obtain complete details regarding the study's motives along with its processes and possible dangers before signaling their consent. Written consent is obtained.

All personal data receives anonymized treatment while participant responses get stored under secure conditions. No identifying information is shared.

The research study allows free participation because participants maintain the right to exit without facing negative outcomes.

The study provides accessibility accommodations through assistive technologies together with alternative format options to build an inclusive research environment for participants with disabilities.

Through ethical research methods and a combination of research approaches the study intends to produce extensive knowledge about accessibility issues and usability problems that new AR e-commerce users encounter and generate practical solutions that will enhance the experience.

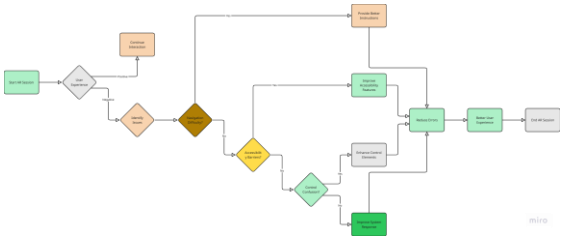
IV. RESULTS

Research established various ergonomic difficulties that first-time e-commerce AR users encounter during their interactive sessions. User navigation through the system proved complicated because users struggled to figure out effective ways to interact with the virtual reality features. Users required more time for task completion along with increased errors in their attempts which demonstrated they had problems mastering the interface. Users demonstrated negative feelings because they found the control elements confusing and the system responses slow which degraded their entire experience.

Detailed accessibility barriers emerged as a main issue especially regarding users with disabilities. The users who were visually impaired faced difficulties navigating AR features because these features did not provide appropriate screen reader functionality. Users encountered problems reading the interface due to small fonts and insufficient contrast alongside difficulties using gestures that proved challenging for people with motor impairments when using AR applications. Users reported multiple issues related to the absence of alt text for AR features because this deficiency impedes accessibility for people using assistive technology.

Statistical data revealed a robust negative correlation relationship between the difficulty of user navigation and successful task completion by the users. The success rates of first-time users showed higher error rates compared to more experienced users of AR applications because they lacked proper onboarding instructions. Users who have disabilities presented worse success rates than what general users achieved which underscores the necessity for better accessibility features.

E-commerce users displayed a mostly neutral attitude toward AR technology given its potential advantages but they identified numerous usability and accessibility problems. The research shows that better interface simplification, improved instructions and better accessibility functions would significantly enhance the initial AR user experience.



V. DISCUSSION

Interpretation of Results

Users who are new to e-commerce technology experience major usability together with accessibility issues during their interactions with AR features. Users encountered problems from complex navigation systems which combined with many errors and unclear control elements to block efficient use and resulted in longer tasks and reduced satisfaction. Accessible features remain challenging to users with disabilities because AR systems provide insufficient screen reader capabilities along with complicated gesture-based control methods. Analyzing the current AR implementation reveals that its inconvenient nature creates challenges for beginner online shoppers.

Task success rates decrease when first-time users encounter complex AR interfaces during their navigation through such systems. Observational data matches the registered frustration patterns and the recorded moderate satisfaction results. The substantial gap in error frequencies between senior users and newbies establishes that AR systems need training time to adopt which supports friendly interface design initiatives.

Comparison with Existing Literature

The outcomes from this study match the current research regarding AR usability in digital commerce settings. The combination of beneficial AR properties such as enhanced engagement through improved product visualization also causes some users to avoid fully adopting the technology due to its complexity. Rese et al. (2017) reported that AR enhances purchase confidence through their research but it needs easy to use interaction design to guarantee usability. Javornik (2016) pointed out that the intensive nature of AR creates cognitive problems which leads to navigation issues among initial users.

This investigation focuses on accessibility problems to a greater extent compared to other research which has been published. Previous research on user experiences primarily analyzed usability but this paper explores the essential barriers as the absence of assistive technologies together with deficient inclusive design. Recent debates about inclusive digital environments match the findings regarding emerging technologies especially in AR.

Implications of Findings

The research findings create crucial implications that benefit both e-commerce businesses together with AR software developers and UX system designers.

The usability for fresh users strengthens when designers create understandable instructional guides and intuitive controls as well as basic navigation systems. Guided tutorials together with real-time feedback systems help users minimize cognitive overload in their interaction with AR applications.

Attempts to increase accessibility in development should include assistive technologies such as screen reader support and voice commands and alternative interaction methods to support users with disabilities. A solution to these accessibility problems will lead to a more all-encompassing AR shopping environment for users.

Addressing accessibility issues and usability problems will enable augmented reality technology to achieve increased online shopping involvement which improves customer satisfaction levels as well as conversion rates.

Limitations of the Study

The study delivers important findings yet its results remain limited by specific factors.

The diverse participants in this research were excellent but substantial growth in participant numbers would enhance the study's generalization potential.

The research examined AR space on just a few e-commerce platforms because of platform and device restrictions. Evaluating AR-enabled e-commerce usability requires more research into different platform types and technical devices.

The research study mainly examined first-time users as part of its testing protocol. The researchers did not

study how users would adapt their behavior to AR interfaces over time nor their long-term engagement with these systems even though this understanding could help explain how users learn to use AR shopping interfaces.

Suggestions for Future Research
Researchers should develop further investigations by expanding the scope of this study using these approaches:

The study should follow users throughout time to monitor their experience progression with repeated encounters of AR shopping tools.

Testing the usability together with accessibility throughout several AR e-commerce platforms will generate insights about preferred implementation strategies.

Adaptive user interfaces should undergo research to determine how they adjust their presentation according to personal choice and disability needs.

- Neurodivergent User Experiences: Examining how AR usability and accessibility impact individuals with cognitive disabilities such as ADHD or autism.

Future investigation of these areas will lead to user-friendly and inclusive AR technology development which will improve e-commerce technology adoption and effectiveness.

CONCLUSION

The research evaluated difficulties encountered by new users during AR adoption in e-commerce systems. Research shows that although Augmented Reality presents opportunities for better online purchases through interactive viewings it faces major implementation hurdles.

Users encountered three main usability issues during their first-time use of AR e-commerce platforms because they faced complex navigation along with many errors and uncertain interaction elements that led to longer task completion times and frustration. First-time users experienced considerable confusion with AR components mainly because of the requirement for smarter design solutions including clear instructional materials.

A significant problem for users with disabilities occurred through the accessibility barriers that were increasingly prominent. People with disabilities faced usability challenges because of screen reader absent functionality combined with poor color contrast and complicated gesture-based system interactions. The importance emerges for implementating assistive technology into consumer systems because it enables AR to be usable by everyone.

The study proved through statistical examination that complex navigation systems decrease user performance thus demonstrating that first-time users need simple AR interfaces. Users experiencing different error levels reveal how insufficient guidance makes it difficult for new users to accept AR applications.

Final Thoughts
The successful implementation of AR in e-commerce requires essential solutions for the detected obstacles. User experience improves dramatically when navigation tools become simpler and guidance steps become more instructive while implementing accessible features into the system. Augmented Reality experiences that are designed to be simple and wheelchair-friendly enable businesses to better interact with customers through more effective promotions and generate improved sales across their digital marketplace.

Studies need to investigate how users maintain their interaction with AR platforms and make comparisons between different platforms while also examining how customized AR interfaces affect participants. E-commerce platforms will achieve complete transformation through online shopping by developing AR technology with user-centered refinement approaches.

REFERENCES

[1] Javornik, A. (2016). "The Mainstreaming of Augmented Reality: A Systematic Review of Its Impact on Consumer Behavior." *Journal of Retailing and Consumer Services*, 30, 252-261. https://doi.org/10.1016/j.jretconser.2016.02.004

[2] Rese, A., Baier, D., Geyer-Schulz, A., & Schreiber, S. (2017). "How Augmented Reality Applications Enhance Product Visualization in

Online Retail: An Experimental Analysis." *Electronic Commerce Research*, 17(4), 429-459. https://doi.org/10.1007/s10660-016-9248-7

[3] Dünser, A., Billinghurst, M., Wen, J., Lehtinen, V., & Nurminen, A. (2012). "Exploring the Use of Augmented Reality for Accessibility." *Personal and Ubiquitous Computing*, 16(1), 29-35. https://doi.org/10.1007/s00779-011-0380-8

[4] Kim, J., & Forsythe, S. (2008). "Adoption of Virtual Try-on Technology for Online Apparel Shopping." *Journal of Interactive Marketing*, 22(2), 45-59. https://doi.org/10.1002/dir.20113

[5] Poushneh, A., & Vasquez-Parraga, A. Z. (2017). "Discernible Impact of Augmented Reality on Retail Customer's Experience, Satisfaction, and Willingness to Buy." *Journal of Retailing and Consumer Services*, 34, 229-234. https://doi.org/10.1016/j.jretconser.2016.10.005

[6] Moreno, R., & Mayer, R. E. (2007). "Interactive Multimodal Learning Environments." *Educational Psychology Review*, 19(3), 309-326. https://doi.org/10.1007/s10648-007-9047-2

[7] Schwerdtfeger, B., & Klinker, G. (2008). "Supporting Collaboration in Distributed Augmented Reality Environments." *IEEE Virtual Reality Conference*, 59-66. https://doi.org/10.1109/VR.2008.4480754

[8] Wang, K., Matsukura, H., Iwai, D., & Sato, K. (2018). "Stabilizing Graphically Extended Hand for Hand Tremors." *IEEE Access*, 6, 28838-28847. https://doi.org/10.1109/ACCESS.2018.2839601

[9] Gupta, T., Sisodia, M., Fazulbhoy, S., Raju, M., & Agrawal, S. (2019). "Improving Accessibility for Dyslexic Impairments Using Augmented Reality." *2019 International Conference on Computer Communication and Informatics (ICCCI)*, 1–4. https://doi.org/10.1109/ICCCI.2019.8822087

[10] Thelijjagoda, S., Chandrasiri, M., Hewathudalla, D., Ranasinghe, P., & Wickramanayake, I. (2019). "The Hope: An Interactive Mobile Solution to Overcome the Writing, Reading and Speaking Weaknesses of Dyslexia." *2019 14th International Conference on Computer Science & Education (ICCSE)*, 808–813. https://doi.org/10.1109/ICCSE.2019.8845516

[11] Gerling, K.M., Kalyn, M.R., & Mandryk, R.L. (2013). "KINECTWheels: Wheelchair-Accessible Motion-Based Game Interaction." *CHI'13 Extended Abstracts on Human Factors in Computing Systems*, 3055–3058. https://doi.org/10.1145/2468356.2479613

[12] Abid, M., Bhimra, M.A., Mubeen, M., Zahid, A.B., & Shahid, S. (2018). "Peppy: A Paper-Based Augmented Reality Application to Help Children Against Dysgraphia." *Proceedings of the 18th ACM International Conference on Interaction Design and Children*, 544–549. https://doi.org/10.1145/3311927.3325315