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**Role of Augmented Reality in Improving Remote Technical Support
in Nigeria**

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Technical Support in Nigeria**



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Abstract

Purpose: The aim of the study was to evaluate the role of augmented reality in improving remote technical support in Nigeria.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: The integration of Augmented Reality (AR) in remote technical support in Nigeria has significantly enhanced troubleshooting efficiency by allowing technicians to visualize issues in real-time, providing immediate and interactive guidance. This technology has improved customer satisfaction by reducing downtime and accelerating resolution processes, making support more accessible, especially in remote areas. Additionally, AR has contributed to cost reduction by minimizing the need for physical technician visits and extensive in-person training sessions.

Unique Contribution to Theory, Practice and Policy: Technology acceptance model (TAM), media richness theory (MRT) & cognitive load theory (CLT) may be used to anchor future studies on role of augmented reality in improving remote technical support in Nigeria. Implement AR solutions to provide remote technicians with detailed, real-time visual overlays that guide diagnostic and repair processes. Formulate policies that establish standards for AR technology in remote technical support. This includes guidelines for data security, privacy, and interoperability to ensure that AR solutions are safe, reliable, and can work seamlessly with other technologies.

Keywords: *Augmented Reality, Improving Remote Technical Support*

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INTRODUCTION

Remote technical support has become increasingly effective and indispensable, particularly in developed economies such as the USA and Japan. In the USA, the adoption of remote support solutions grew by 40% between 2018 and 2022, driven by advancements in cloud technology and the widespread availability of high-speed internet (Smith, 2019). Companies such as IBM and Microsoft have reported significant reductions in customer service costs and improvements in resolution times, with customer satisfaction rates exceeding 90% due to the convenience and efficiency of remote support (Johnson, 2020). Similarly, in Japan, remote support has been crucial for maintaining business continuity during the COVID-19 pandemic, with firms like Fujitsu and NEC leveraging remote diagnostic tools to enhance support efficiency. A study highlighted that Japanese companies experienced a 30% increase in first-time resolution rates and a 25% reduction in downtime through the use of remote technical support (Tanaka, 2021).

In the United Kingdom, the utilization of remote support services has surged, particularly among IT and software companies. Between 2017 and 2021, the adoption of remote support tools increased by 35%, primarily due to the growing demand for efficient and cost-effective technical solutions (Taylor & Harper, 2021). Major companies like BT Group and Sage have implemented remote support to streamline their customer service operations, achieving a 20% reduction in service response times and a 25% improvement in customer satisfaction ratings (Evans, 2020). Additionally, the healthcare sector in the UK has benefited significantly from remote support, with a 30% increase in the resolution of IT-related issues in medical facilities, thus ensuring uninterrupted patient care (Hughes, 2019).

In Germany, remote technical support has become a cornerstone of the manufacturing and automotive industries. Companies such as Siemens and Volkswagen have leveraged remote support to enhance their maintenance and troubleshooting processes. From 2018 to 2022, there was a 40% increase in the use of remote support solutions in the German manufacturing sector, resulting in a 15% decrease in equipment downtime and a 20% boost in production efficiency (Müller & Schmidt, 2020). The German government has also supported this trend by investing in digital infrastructure, enabling more reliable and faster remote support services across various industries (Koch & Weber, 2021). This widespread adoption underscores the critical role of remote technical support in maintaining operational efficiency and competitiveness in developed economies.

In developing economies, remote technical support is emerging as a viable solution to bridge the gap in technical expertise and service availability. For instance, in India, the remote support market has expanded by 50% over the past five years, fueled by the proliferation of smartphones and affordable internet access (Chaudhary & Singh, 2020). Indian companies like TCS and Infosys are leveraging remote support to offer timely assistance, resulting in a 35% reduction in operational costs and a 40% improvement in service delivery times. In Brazil, the adoption of remote support tools has led to a significant increase in service efficiency, with a reported 30% decrease in service turnaround time and enhanced customer satisfaction (Pereira et al., 2019). These trends underscore the potential of remote technical support to drive operational efficiencies and improve service delivery in developing economies.

In Brazil, the adoption of remote support services has grown substantially, particularly in the financial and telecommunications sectors. From 2016 to 2020, the number of companies utilizing remote support solutions increased by 45%, driven by the need to reduce operational costs and improve service delivery (Pereira & Almeida, 2019). Brazilian firms such as Banco do Brasil and Vivo have reported significant improvements in service efficiency, with a 30% reduction in service turnaround times and a 25% increase in customer satisfaction (Silva & Santos, 2020).

India has also seen significant advancements in remote technical support, especially in the IT and software development sectors. The remote support market in India grew by 50% over the past five years, facilitated by the widespread availability of affordable internet and mobile devices (Chaudhary & Singh, 2020). Companies like Infosys and Tata Consultancy Services have successfully implemented remote support to enhance their technical service capabilities, resulting in a 40% improvement in problem resolution times and a 35% reduction in operational costs (Rao & Gupta, 2019). These trends highlight the potential of remote technical support to drive efficiency and customer satisfaction in developing economies.

In sub-Saharan Africa, remote technical support is becoming a critical component of IT service management, especially in countries like Kenya and Nigeria. The region has seen a 60% increase in the utilization of remote support solutions over the past five years, primarily due to improved internet infrastructure and the growing demand for IT services (Ochieng & Akinola, 2021). In Kenya, companies like Safaricom and Kaspersky have successfully implemented remote support to enhance customer service, achieving a 50% reduction in service resolution times and a 45% increase in customer satisfaction (Mwangi, 2020). Nigeria has also experienced significant benefits from remote technical support, with businesses reporting a 40% improvement in technical issue resolution and substantial cost savings (Adebayo & Adeyemi, 2019). These examples highlight the effectiveness of remote technical support in addressing service delivery challenges and boosting customer satisfaction in sub-Saharan economies.

In Kenya, the adoption of remote support solutions has increased by 60% over the past five years, largely due to improvements in internet infrastructure and the growing demand for reliable IT services (Ochieng & Akinola, 2021). Companies such as Safaricom and Kaspersky have implemented remote support systems to enhance customer service, achieving a 50% reduction in service resolution times and a 45% increase in customer satisfaction (Mwangi, 2020).

Nigeria has also experienced significant benefits from remote technical support, particularly in the banking and telecommunications sectors. The use of remote support solutions in Nigeria grew by 55% between 2017 and 2021, leading to a 40% improvement in technical issue resolution and substantial cost savings for businesses (Adebayo & Adeyemi, 2019). Companies like MTN and Access Bank have leveraged remote support to maintain high service standards, despite challenges such as intermittent power supply and limited technical expertise. These examples underscore the effectiveness of remote technical support in addressing service delivery challenges and boosting customer satisfaction in sub-Saharan economies.

Augmented Reality (AR) tools have revolutionized remote technical support by enhancing the interaction between support personnel and users. AR tools like Microsoft HoloLens, TeamViewer Pilot, ARKit by Apple, and PTC's Vuforia provide immersive experiences that allow technicians

to visualize and solve problems in real-time, irrespective of geographical constraints. Microsoft HoloLens, for instance, enables remote experts to overlay digital instructions onto physical objects, significantly reducing the time required to troubleshoot and repair equipment (Repetto, 2021). TeamViewer Pilot leverages AR to guide users through complex procedures by overlaying visual cues on their devices, enhancing clarity and reducing errors (Schwerdtfeger & Klinker, 2018). Similarly, ARKit and Vuforia offer robust platforms for creating custom AR experiences that can be tailored to specific technical support needs, facilitating a more interactive and effective support environment (Gavish, 2015).

These AR tools significantly enhance the effectiveness of remote technical support by improving the accuracy and efficiency of troubleshooting processes. The immersive nature of AR allows support technicians to provide real-time, visual guidance, which can reduce misunderstandings and accelerate problem resolution. Studies have shown that using AR in remote support can reduce downtime by up to 50% and improve first-time fix rates by 30% (Repetto, 2021). Furthermore, AR tools can help capture and analyze data on common issues, enabling companies to refine their support processes and improve overall service quality. By integrating AR tools into remote technical support, companies can offer more responsive, efficient, and effective support services, ultimately leading to higher customer satisfaction and reduced operational costs (Schwerdtfeger & Klinker, 2018).

Problem Statement

The rapid advancement in technology has necessitated the need for effective and efficient technical support solutions, particularly in remote environments. Traditional remote support methods, which primarily rely on verbal communication and screen sharing, often fall short in addressing complex technical issues due to limitations in visual clarity and real-time interactivity. This inadequacy results in prolonged resolution times, increased operational costs, and diminished customer satisfaction. Augmented Reality (AR), which overlays digital information onto the physical world, presents a promising solution to these challenges by enhancing the visual and interactive capabilities of remote technical support (Kipper & Rampolla, 2022). Despite its potential, the adoption of AR in remote technical support remains limited, and its effectiveness in real-world applications has not been extensively studied. Research indicates that AR can significantly improve troubleshooting efficiency and accuracy, yet empirical evidence supporting these claims is sparse (Azuma, 2021).

This study aims to explore the role of Augmented Reality in improving remote technical support, examining its impact on resolution times, cost efficiency, and user satisfaction. By addressing these gaps, this research will contribute to a deeper understanding of how AR can be effectively integrated into remote support systems, potentially revolutionizing the way technical issues are resolved across various industries (Billinghurst, Clark, & Lee, 2020; van Krevelen & Poelman, 2021).

Theoretical Framework

Technology acceptance model (TAM)

Originated by Fred Davis in 1989, the Technology Acceptance Model (TAM) explains how users come to accept and use a technology. The model posits that perceived usefulness and perceived

ease of use significantly influence users' attitudes towards technology adoption. In the context of augmented reality (AR) in remote technical support, TAM helps to understand how technicians and customers perceive the benefits and usability of AR tools. If users find AR applications easy to use and beneficial for troubleshooting and maintenance, their adoption is more likely to be successful (Wirtz, 2021).

Media Richness Theory (MRT)

Proposed by Richard L. Daft and Robert H. Lengel in 1986, Media Richness Theory (MRT) suggests that communication effectiveness depends on the medium's ability to convey information and reduce uncertainty. Rich media, such as face-to-face interactions, provide immediate feedback and multiple cues. AR, as a rich medium, enhances remote technical support by offering interactive and immersive experiences that can replicate in-person assistance, thus improving problem resolution efficiency and customer satisfaction (Dennis et al., 2018).

Cognitive Load Theory (CLT)

Developed by John Sweller in the late 1980s, Cognitive Load Theory (CLT) focuses on the amount of mental effort required to process information. It asserts that instructional methods should avoid overloading the cognitive capacities of learners. AR in remote technical support can help reduce cognitive load by providing visual aids and step-by-step guidance, making complex technical tasks more manageable and less mentally taxing for users (Choi et al., 2020).

Empirical Review

Johnson (2019) investigated the impact of augmented reality (AR) on remote maintenance tasks within the manufacturing sector. The purpose of the study was to determine how AR could enhance the efficiency and accuracy of maintenance operations remotely. Using a mixed-methods approach, the researchers gathered quantitative data through performance metrics and qualitative data via technician interviews. Their findings revealed that AR significantly reduced equipment downtime and improved task accuracy, leading to more efficient maintenance processes. The study concluded with a recommendation for broader implementation of AR technology in the manufacturing sector, along with continuous training programs for technicians to ensure they remain proficient in using AR tools. Johnson et al. highlighted the importance of addressing potential challenges such as the initial cost of AR systems and the need for robust training modules.

Li and Chen (2020) explored the effectiveness of AR in IT support environments through a quasi-experimental design. The study aimed to measure the impact of AR on the resolution time and user satisfaction in IT support scenarios. Participants were divided into two groups: one utilizing traditional support methods and the other using AR-based support tools. The results indicated a substantial 30% reduction in resolution time for the AR group, alongside significantly higher user satisfaction scores. Based on these findings, the researchers recommended integrating AR into IT service desks to enhance support efficiency and user experience. They also suggested that organizations invest in user-friendly AR interfaces and provide regular training to support staff to maximize the benefits of AR technology.

Martin (2021) assessed the impact of AR-based support on diagnostic precision and service time. The purpose was to determine whether AR could streamline technical support processes in

automotive repair and maintenance. Through detailed observations and performance tracking, the study found that AR-based support improved diagnostic precision and reduced service time by approximately 25%. The researchers recommended that automotive companies invest in user-friendly AR interfaces and ensure technicians receive adequate training to fully leverage the technology. They also emphasized the potential for AR to improve customer satisfaction by enabling faster and more accurate repairs.

Kim (2018) explored the role of AR in remote medical support through a survey-based study. The purpose was to understand how AR could enhance communication and reduce error rates in medical support scenarios. The survey collected responses from healthcare professionals who had experience using AR for remote support. The findings indicated that AR significantly enhanced communication between remote medical teams and reduced error rates in patient care. The researchers concluded that developing standardized AR protocols for healthcare could further improve the efficiency and reliability of remote medical support. They recommended continuous updates and maintenance of AR systems to ensure they remain effective in rapidly changing medical environments.

Garcia and Lopez (2020) evaluated the effectiveness of AR tools in improving technician efficiency and accuracy. The study aimed to measure how AR could enhance the performance of technical support staff in troubleshooting and repairing telecommunications equipment. The experiment involved technicians using AR tools compared to those using traditional methods. The results showed that AR tools significantly improved technician efficiency and accuracy. Based on these findings, the researchers recommended regular updates and maintenance of AR systems to keep them current with technological advancements. They also suggested that telecommunications companies invest in continuous training programs for their technical support staff to maximize the benefits of AR.

Ahmed (2019) examined the impact of AR on technical support for complex systems. The purpose was to determine how AR could enhance the efficiency and accuracy of technical support in aerospace operations. Over the course of the study, data were collected on the performance of technical support teams using AR tools. The findings demonstrated that AR significantly enhanced the efficiency and accuracy of technical support for complex aerospace systems. The researchers recommended continuous upgrades to AR technology to keep pace with advancements in the aerospace industry. They also highlighted the need for ongoing training for support personnel to ensure they can effectively use AR tools in their operations.

Brown (2021) evaluated the role of AR in remote education technical support. The study aimed to measure the impact of AR on problem-solving skills among users in educational settings. Participants were divided into two groups: one using traditional support methods and the other using AR-based support tools. The results showed that the AR group demonstrated significantly improved problem-solving skills compared to the traditional support group. Based on these findings, the researchers recommended integrating AR into educational tech support services to enhance the problem-solving abilities of users. They also suggested that educational institutions invest in developing user-friendly AR interfaces and provide regular training for support staff to ensure the effective use of AR technology.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptual Gaps: While the studies highlighted the benefits of AR in various sectors, none explored the integration of AR with machine learning (ML) for predictive maintenance in manufacturing. The combined use of AR for real-time visualization and ML for predictive analytics could potentially revolutionize maintenance processes by enhancing predictive accuracy and operational efficiency (Johnson, 2019; Li & Chen, 2020). Most studies focused on immediate improvements in efficiency and accuracy due to AR, but they lacked an in-depth analysis of the long-term impact and return on investment (ROI) of AR implementations. A comprehensive study examining the sustained benefits and financial implications over time would fill this gap (Martin, 2021; Garcia & Lopez, 2020). Although Kim (2018) touched on the need for standardized AR protocols in healthcare, there is a broader need for standardized implementation frameworks across different industries. This would ensure consistency and interoperability of AR systems, enhancing their effectiveness and adoption rates across various sectors.

Contextual Gaps: While the studies covered a range of industries, including IT, automotive, healthcare, telecommunications, aerospace, and education, there was a lack of focus on the specific challenges and requirements of the manufacturing sector. Understanding sector-specific barriers, such as equipment diversity and maintenance schedules, would provide valuable insights for AR implementation in manufacturing (Johnson, 2019; Ahmed, 2019). Several studies emphasized the need for training but did not thoroughly investigate the human factors and user experience aspects of AR tools. Research focusing on how technicians interact with AR systems, the learning curve, and user acceptance would be beneficial for optimizing AR deployment in maintenance tasks (Brown, 2021; Garcia & Lopez, 2020). The studies predominantly addressed AR implementation in large organizations, leaving a gap in understanding how SMEs can adopt and benefit from AR technology. Investigating the scalability and cost-effectiveness of AR solutions for smaller firms could help democratize access to advanced maintenance technologies (Li & Chen, 2020; Kim, 2018).

Geographical Gaps: Most research focused on AR implementation in developed regions. There is a significant gap in understanding how AR can be adopted and adapted in developing countries with different technological infrastructures, regulatory environments, and market conditions. Studies in diverse geographical contexts would provide a more comprehensive view of AR's global applicability (Johnson, 2019; Martin, 2021). The studies did not explore how cultural differences might impact the adoption and effectiveness of AR technology. Research examining the influence

of cultural factors on the perception and use of AR in maintenance tasks could offer valuable insights for tailoring AR solutions to various cultural contexts (Ahmed, 2019; Brown, 2021).

CONCLUSION AND RECOMMENDATIONS

Conclusions

Augmented Reality (AR) has emerged as a transformative tool in enhancing remote technical support across various industries. Its ability to overlay digital information onto the physical world offers significant advantages in troubleshooting, training, and maintenance tasks. By providing real-time, visual guidance and interactive instructions, AR bridges the gap between remote experts and on-site technicians, leading to faster problem resolution and reduced downtime. This technology not only enhances the accuracy and efficiency of remote support but also minimizes travel costs and environmental impact by reducing the need for physical presence. Furthermore, AR's intuitive interface facilitates knowledge transfer, making it easier for less experienced technicians to perform complex tasks with confidence. As AR technology continues to evolve, its integration with other advanced technologies like IoT and AI holds the potential to further revolutionize remote technical support, making it more dynamic and responsive. Despite its current limitations, such as the need for specialized equipment and potential cybersecurity concerns, the benefits of AR in remote technical support are undeniable. Future research and development efforts should focus on overcoming these challenges and expanding the accessibility and functionality of AR solutions. In conclusion, AR represents a powerful tool that significantly improves the quality and efficiency of remote technical support, offering substantial benefits to businesses and customers alike.

Recommendations

Theory

Research should explore the theoretical frameworks that integrate augmented reality (AR) and machine learning (ML) to enhance remote technical support. This involves developing models that explain how AR can be used to visualize data processed by ML algorithms in real-time, providing a comprehensive support system that predicts issues and suggests solutions dynamically. Theories of user interaction and experience should be expanded to include the impact of AR on remote technical support. Understanding how AR interfaces affect user engagement, learning curves, and efficiency can contribute to the development of more intuitive and effective AR applications in technical support. Investigate how AR facilitates knowledge transfer and learning in remote technical support environments. This includes examining how AR can bridge the gap between novice and expert users, enabling effective learning and skill acquisition through immersive and interactive experiences.

Practice

Implement AR solutions to provide remote technicians with detailed, real-time visual overlays that guide diagnostic and repair processes. This can significantly reduce the time and errors associated with traditional remote support methods, improving overall service quality and customer satisfaction. Utilize AR to facilitate real-time collaboration between remote technicians and on-site personnel. AR can enable experts to provide visual guidance and instructions to field workers,

enhancing the efficiency and effectiveness of technical support and training programs. Develop and implement standardized AR tools and platforms that can be easily adopted across various industries. This includes creating user-friendly AR interfaces and ensuring compatibility with existing technical support systems to streamline the integration process.

Policy

Formulate policies that establish standards for AR technology in remote technical support. This includes guidelines for data security, privacy, and interoperability to ensure that AR solutions are safe, reliable, and can work seamlessly with other technologies. Governments and industry bodies should provide incentives for the adoption of AR in remote technical support. This could include grants, tax breaks, or subsidies for companies investing in AR technologies to enhance their support services. Develop policies that support workforce development and training in AR technologies. This includes funding for educational programs and certifications that prepare the workforce to effectively use AR in remote technical support roles, ensuring a skilled and competent labor force.

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