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Design and Construction of a Locally Fabricated Automated Audio-Visual Slides Projector with Remote Control for Enhanced Teaching and Learning Sciences in Nigerian Schools

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Abstract:- This research project addresses the critical need for accessible educational technology in off-grid rural schools lacking reliable electricity. The focus of this study is the development and implementation of a locally fabricated and automated audio-visual slides projector, designed specifically for deployment in environments where conventional power infrastructure is absent. The core innovation lies in integrating solar power as a sustainable backup source to ensure continuous functionality in the targeted rural school settings (Iji et al (2014) The absence of reliable electricity in these rural schools poses a significant obstacle to the integration of modern educational tools. This project aims to overcome this challenge by providing a tailored solution that combines automation features with renewable energy sources. As we delve into the technical intricacies of the fabricated audio-visual material, it becomes apparent that its design is optimized for durability and efficiency in resource-constrained environments (Iji et al (2014).This research is guided by a commitment to advancing inclusive education and technological empowerment in underserved communities. By utilizing solar power as a backup source, the proposed audio-visual solution not only addresses the immediate challenges faced by these schools but also contributes to the establishment of a sustainable and resilient educational infrastructure (Onasanya et al; 2011).

Keywords:- *Design, Construction, Locally Fabricated, Automated, Audio-Visual Slides, Projector, Remote Control, and Enhanced Teaching and Learning.*

I. INTRODUCTION

Rural schools in off-grid areas face substantial challenges in providing a quality education due to the absence of reliable electricity. The digital divide between urban and rural educational institutions is exacerbated by the limited access to modern educational tools and technologies. In light of this, the proposed research project seeks to address this disparity by focusing on the development and implementation of a locally fabricated and automated audio-visual slides projector for off-grid rural schools.

The global digital transformation in education has been largely concentrated in areas with established electrical infrastructure, leaving rural and remote schools in developing regions at a distinct disadvantage. The electrification disparities contribute to a stark contrast in the quality of education, limiting the scope for interactive and technology-enhanced learning experiences (Iji et al, 2014).

Research consistently highlights the positive correlation between access to technology and educational outcomes. However, in the context of off-grid rural schools, the lack of electricity hampers the integration of audio-visual aids and other electronic educational resources. This project aims to narrow the technological gap and unlock the potential for improved learning outcomes in these underserved communities (Mboto et al, 2011).

Previous efforts to address this issue have often focused on external interventions that may not be sustainable or suitable for the unique challenges of off-grid environments. The proposed research diverges by emphasizing the development of a locally fabricated solution, acknowledging the need for context-specific technologies that can be maintained and adapted by the communities themselves (Onasanya et al; 2011).

The integration of solar power as a backup source is a pivotal aspect of this research. Recognizing the unreliability of conventional power sources in rural areas, the use of solar energy not only addresses the immediate need for electricity but also aligns with broader sustainability goals. This

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approach ensures that the technology is resilient and can operate efficiently in resource-constrained settings.

Beyond the technical aspects, this research is grounded in the principle of community empowerment. By providing a locally fabricated solution, the project aims to foster a sense of ownership and self-sustainability within the targeted communities. This approach is aligned with the growing emphasison participatory development strategies that consider the social, cultural, and economic contexts of the communities involved.

The necessity to locally construct instructional materials is integral to the broader framework of enhancing educational outcomes in off-grid rural schools. The challenges posed by limited access to electricity and external resources underscore the significance of developing instructional materials within the local context(Onasanya et al; 2011).

Locally constructing instructional materials allows for the integration of culturally relevant content. This approach acknowledges the unique cultural backgrounds of the students and ensures that educational materials resonate with their experiences, fostering a more engaging and meaningful learning environment.

Off-grid rural schools often face resource constraints that limit their ability to procure standardized instructional materials. By promoting local construction, this research addresses the pragmatic need for creating cost-effective and sustainable educational resources tailored to the specific requirements of the community (Mboto et al, 2011).

Educational needs can vary widely across different communities. Local construction empowers educators to adapt and customize instructional materials according to the specific challenges and opportunities present in their context. This flexibility is crucial for addressing the diverse learning needs of students in off-grid areas.

Involving the local community in the construction of instructional materials fosters a sense of ownership and collaboration. This participatory approach not only strengthens community ties but also ensures that the materials created are aligned with the community's values, traditions, and language, thereby enhancing their effectiveness (Mboto et al,2011).

Locally constructed instructional materials are more likely to be sustainable in the long term. The community's direct involvement in their creation facilitates a better understanding of maintenance practices, reducing dependence on external entities. This sustainability aspect is particularly crucial in off-grid settings where external support may be sporadic.

Integrating local knowledge and skills into the construction of instructional materials provides an opportunity to leverage existing technologies within the community. Whether it's the incorporation of traditional craftsmanship or the utilization of locally available resources, this approach maximizes the use of indigenous knowledge and technology.

In summary, the background of this study underscores the urgency of addressing electrification disparities in off-grid rural schools and emphasizes the need for context-specific, sustainable technological solutions. The integration of renewable energy sources in the proposed audio-visual solution signifies a holistic approach towards enhancing education in underserved communities. Through this research, we aspire to contribute not only to the academic discourse on educational technology but also to the practicalRural schools in off-grid areas face substantial challenges in providing a quality education due to the absence of reliable electricity. The digital divide between urban and rural educational institutions is exacerbated by the limited access to modern educational tools and technologies. In light of this, the proposed research project seeks to address this disparity by focusing on the development and implementation of a locally fabricated and automated audio-visual slides projector for off-grid rural schools.

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In summary, the background of this study underscores the urgency of addressing electrification disparities in off-grid rural schools and emphasizes the need for context-specific, sustainable technological solutions. The integration of renewable energy sources in the proposed audio-visual solution signifies a holistic approach towards enhancing education in underserved communities. Through this research, we aspire to contribute not only to the academic discourse on educational technology but also to the practical improvement of learning environments in resource-limited settings.

The need to locally construct instructional materials emerges as a pivotal component in the holistic strategy to enhance education in off-grid rural schools. This approach not only addresses immediate resource constraints but also aligns with the broader goal of empowering communities to take an active role in shaping their educational landscape. Through the intersection of technology, local expertise, and cultural relevance, this research endeavors to contribute to the development of sustainable and impactful educational practices in resource-limited environments (Mboto et al,2011).

- *Problem Statement/Justification:*

In rural educational settings, the scarcity of modern instructional materials poses a formidable challenge to the quality of teaching and learning experiences. One of the primary issues confronting schools in rural areas is the limited access to contemporary audio-visual materials. Unlike their urban counterparts, these schools often lack the necessary infrastructure and resources to procure or produce audio-visual materials that could enhance the pedagogical process. This dearth impedes the comprehensive delivery of educational content, hindering the development of a dynamic and engaging learning environment.

Furthermore, even when modern instructional materials are made available to rural schools, a critical barrier emerges in the form of inadequate technological infrastructure. Many rural schools struggle with limited access to electricity and a lack of appropriate devices, hindering the seamless integration of audio-visual materials into the curriculum. The absence of reliable power sources and compatible devices contributes to a significant digital divide, restricting the potential benefits of multimedia resources in facilitating effective teaching and learning (Ubana, 2009).

The repercussions of these challenges are acutely felt in the reduced quality of teaching and learning experiences within rural schools. The absence of audio-visual materials diminishes the ability of educators to illustrate complex concepts in a visually comprehensible manner. Students are thus deprived of the multisensory learning experiences that have been shown to enhance understanding and retention. Consequently, the educational landscape in rural areas is marked by a stark contrast in instructional quality, perpetuating an inequitable distribution of educational opportunities.

Moreover, even in instances where technological access is improved, language and cultural barriers present additional obstacles. The limited availability of audio-visual materials tailored to local contexts and languages exacerbates the challenge. As a result, the potential benefits

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of these materials are not fully realized, contributing to a disconnection between thecurriculum and the lived experiences of students in rural areas (Babayemi, 2014).

In conclusion, the overarching problem lies in the systemic lack of access to and integration of modern instructional materials, particularly audio-visual resources, in rural schools. This not only compromises the quality of teaching and learning but also perpetuates educational disparities, hindering the holistic development of students in these underserved communities. Addressing these challenges requires a multifaceted approach that encompasses infrastructural improvements, technological empowerment, and the development of context-specific instructional materials tailored to the unique needs of rural educational settings.

➢ *Advantages of Using Projectors in the Classroom for Technology-Based Learning*

Integrating projectors into classroom activities offers a wide range of benefits for technology-driven education. In the modern digital era, adopting technology is essential to create engaging and interactive learning environments. Projectors have become a popular tool in education due to their ability to present visual content on large screens, making learning more dynamic and effective.

- *Enhanced Visual Learning*

Projectors allow educators to deliver visually rich lessons by displaying images, videos, and interactive presentations. This approach caters to various learning preferences and makes classroom content more engaging. Visual aids help simplify complex topics, boost comprehension, and improve knowledge retention, ensuring that students remain attentive and invested in their learning.

- *Encouraging Interactive Teaching*

With projectors, teachers can adopt more interactive teaching methods. Features like touchscreens and interactive whiteboards let educators annotate, emphasize key points, and interact with the projected material. These tools promote student involvement, making lessons more participatory and engaging, while encouraging collaboration and discussion.

- *Supporting Multisensory Learning*

Projectors provide a multisensory learning experience by combining visual, auditory, and sometimes even tactile elements. This approach accommodates a variety of learning styles, helping students grasp and remember information more effectively. It also supports learners with unique strengths and preferences, creating a more inclusive educational environment.

- *Boosting Classroom Efficiency*

Using projectors helps streamline classroom activities by reducing the reliance on physical teaching aids like charts, posters, or transparencies. Teachers can store and organize digital resources more efficiently, minimizing clutter and saving preparation time. Additionally, projectors easily connect with devices such as laptops, tablets, or document cameras, enabling the seamless integration of technology into daily lessons.

➢ *Objective(s) of the Study:*

The study aimed at Designing and Construction of a Locally fabricated Automated Audio-Visual Slides Projector with Remote Control for Enhanced Teaching and Learning in Nigerian Schools

II. LITERATURE REVIEW

➢ *The Imperative for Teaching Aids in Science Education and Their Impact on Student Understanding and Interest*

The effective teaching of sciences is a multifaceted endeavor that necessitates the utilization of diverse pedagogical tools. This literature review delves into the compelling need for teaching aids in science education, elucidating how their incorporation enhances students' comprehension and fosters a heightened interest in the learning process.

Numerous studies underscore the positive correlation between the use of teaching aids and enhanced conceptual understanding in science education (Ubana, 2009). Visual aids, such as diagrams, models, and multimedia presentations, serve as cognitive scaffolds, providing students with tangible representations that facilitate the grasp of abstract scientific concepts ((Ubana, 2009).

Science classrooms are inherently diverse in terms of students' learning styles and preferences. Teaching aids cater to this diversity by offering varied sensory inputs. Visual learners benefit from charts and diagrams, while tactile learners engage with hands-on models and experiments, ensuring a more inclusive and effective learning environment.

Engaging teaching aids have been shown to stimulate curiosity and interest in scientific subjects. Interactive simulations, virtual labs, and real-world applications capture students' attention, transforming the learning experience into an exploration rather than a passive reception of information (Okafor, 2015).

Teaching aids facilitate the integration of real-world examples and applications into science education. By contextualizing scientific principles within tangible scenarios, students develop a deeper appreciation for the relevance and practical implications of scientific concepts.

The multisensory nature of teaching aids contributes to improved information retention and recall. Studies indicate that students exposed to visual aids alongside traditional lectures exhibit higher retention rates and are better able to recall complex scientific information.

For students facing language barriers in science education, visual aids serve as a universal language. Diagrams, charts, and multimedia presentations transcend linguistic constraints, providing a means for all students,

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regardless of language proficiency, to access and understand scientific content (Okafor, 2015).

The advent of digital technologies has further expanded the repertoire of teaching aids in science education. Virtual reality (VR), augmented reality (AR), and interactive simulations offer immersive learning experiences, allowing students to explore complex scientific phenomena in ways previously unattainable (Okafor, 2015).

Teaching aids facilitate dynamic teacher-student interactions. Teachers can use visual aids to elicit discussions, prompt questions, and encourage collaborative problem-solving. This interactive approach not only enhances understanding but also fosters a positive teacher-student relationship.

- *The Significance of Audio-Visual Material in Teaching and Learning Compared to Audio-Only or Visual-Only Approaches*

The integration of multimedia components, specifically audio-visual material, into educational settings has become increasingly prevalent. This literature review examines the importance of audio-visual material in teaching and learning, drawing comparisons with the effectiveness of audio-only and visual-only approaches (Babayemi, 2014).

Studies consistently highlight that the combination of auditory and visual stimuli enhances cognitive engagement and information retention compared to singular modalities. The multimedia nature of audio-visual material provides a richer learning experience, allowing students to process and retain information more effectively (Babayemi, & Olagunju, 2015).

Dual Coding Theory posits that combining verbal and visual information aids in better understanding and memory recall. Audio-visual material aligns with this theory, providing learners with multiple channels for processing information, reinforcing the educational content through both auditory and visual pathways.

Research suggests that audio-visual material facilitates improved comprehension and conceptual understanding compared to audio-only or visual-only methods. The dynamic interplay of auditory and visual elements helps clarify abstract concepts, making complex topics more accessible to learners (Babayemi, 2014).

The incorporation of visual elements in audio-visual material captures and sustains students' attention more effectively than purely auditory presentations. Visual stimuli, when synchronized with auditory information, contribute to increased engagement, reducing the likelihood of cognitive overload and enhancing overall focus (Babayemi, & Olagunju, 2015).

Audio-visual material, especially when incorporating real-world scenarios, enhances the authenticity of educational content. The contextualization of information through audio-visual means provides a more realistic representation of concepts, promoting a deeper understanding of their practical applications (Babayemi, & Olagunju, 2010)

The multisensory nature of audio-visual material accommodates varied learning styles. While some learners may benefit more from auditory input, others may be visual learners. Audio-visual presentations strike a balance, ensuring that information is accessible to a broader spectrum of students.

Advances in technology have facilitated the seamless integration of audio-visual material into educational platforms. This accessibility enables learners to engage with content through various devices, fostering flexibility in learning environments and accommodating diverse educational settings (Babayemi, & Olagunju, 2015).

- *Challenges of Audio-Only and Visual-Only Approaches*

While audio-only and visual-only methods have their merits, they also present limitations. Audio-only approaches may lack the visual context necessary for certain concepts, while visual-only methods may overlook the reinforcing impact of auditory cues. The combination of both in audio-visual material aims to address these shortcomings (Babayemi, & Olagunju, 2010).

III. METHODOLOGY

- *Summary of Key Activities*

- Activity 1: identification of subject andits corresponding topics to be projected
- Activity2: identification of various diagrams in the selected topic to be projected
- Activity3: choosing of appropriate audio sound to use that will suit the diagram selected for projection
- Activities 4**:** planning Dimension of the size of projector to be constructed
- Activities 5: choosing of materials to be used for the casement
- Activities 6: coupling of the electrical components
- Activities 7: packaging
- Activities 8: test running
- Activities 9: Finishing,Labeling, Automation andBranding:This the final stage where finishing touches will be put in place on the instructional materials produce so as for it to measure and serve the purpose it was designed to do. And lastly, the produce instructional materials shall caries the name of the researcher institution and TETFUND as the sponsor

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➢ *Picture Gallery/Step by Step Process*

Image 1 Planing Stage Setting Dimension

Image 2 Contruction of Casing Stage Stage Contruction of Roller

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Image 3 Test Running the Roller

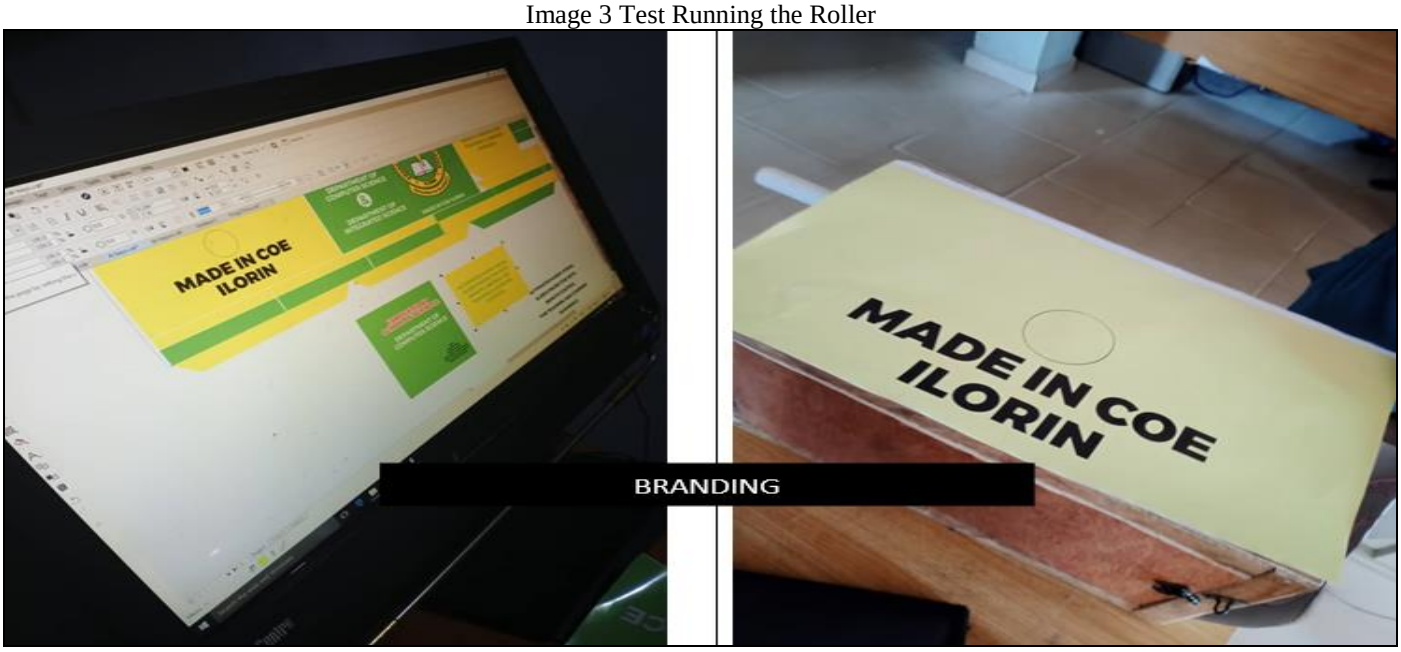

Image 4 Branding

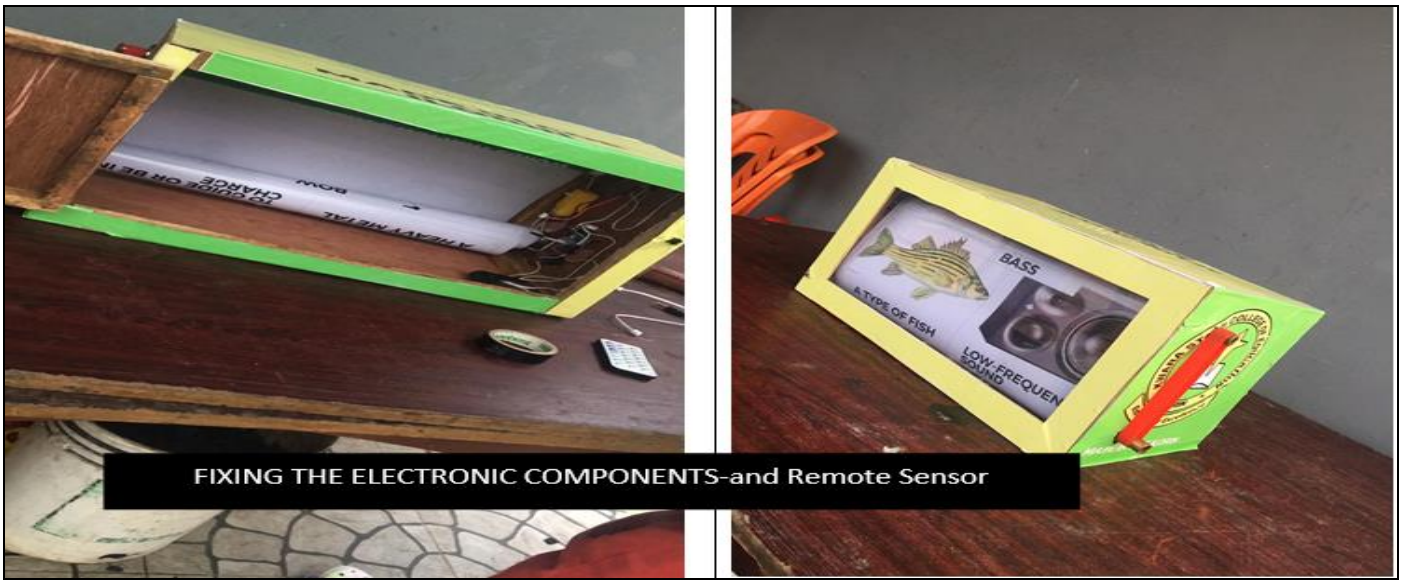

Image 5 Fixing the Electronic Components and Remote Sensor

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Image 6 Test Running

- Activity 10**: Data Analysis**

No primary or secondary data is expected to be collected.

- Activity 11: **Dissemination Workshop and Media Chats**

Workshop for both awareness and training on the use constructed materials was organized for teacher and students in Kwara state. The workshop run for five days, with practical experience on how construct same Video Documentary was produced and shared on all popular social media platforms for mass adoption.

IV. RESULTS

➢ *(Expected Outputs/Results):*

The anticipated outcome of this research was the successful development and implementation of a locally fabricated audio-visual projector tailored for use in rural schools. It is expected that the integration of this technology will enhance the teaching and learning experiences by providing a cost-effective and sustainable solution for delivering audio-visual educational content. The research aims to identify technical specifications, address usability considerations, and propose solutions to potential challenges associated with the deployment of the projector. Ultimately, the goal is to contribute to an improved educational environment in rural schools, fostering engagement, comprehension, and overall academic performance.

V. CONCLUSION

This research has demonstrated the feasibility and importance of developing a locally fabricated automated audio-visual slides projector with remote control, specifically tailored for deployment in off-grid rural schools in Nigeria. By integrating solar power as a sustainable backup energy source, this innovation addresses the critical challenge of unreliable electricity in underserved communities. The project underscores the value of designing context-specific educational tools that are not only cost-effective but also durable and easy to maintain within local environments.

The successful implementation of this technology is expected to bridge the digital divide between urban and rural schools by providing an accessible platform for enhanced teaching and learning. By incorporating automation and audio-visual capabilities, the projector offers a multisensory learning experience that fosters deeper understanding and engagement among students. Furthermore, this research aligns with the broader goals of educational equity and sustainability, empowering local communities to actively participate in the creation and utilization of instructional technologies. The anticipated dissemination of this innovation through workshops, training sessions, and media outreach ensures its adoption and replication across similar contexts. This initiative serves as a step towards creating resilient and inclusive educational systems, where the potential of every student, regardless of their geographic location, can be fully realized. Ultimately, the findings and outcomes of this study contribute to the growing discourse on educational technology and sustainable development in resource-constrained settings.

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➢ *Declaration of Author Contribution*

This publication titled **"Design and Construction of a Locally Fabricated Automated Audio-Visual Slides Projector with Remote Control for Enhanced Teaching and Learning in Nigerian Schools"** reflects the collaborative effort of the authors listed below, with each contributing in the roles specified:

- *Amao Habeeb:*

Served as the **Principal Researcher**, leading the conceptualization, design, construction, and testing of the automated audio-visual slides projector. He was responsible

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for coordinating the research activities, supervising the technical aspects of the project, and drafting the manuscript for publication.

- *Dr. Bello Zakariyau Adebayo:*

Served as a **Research Assistant and Technical Crew Member**, providing critical input during the experimental setup, troubleshooting, and refinement stages of the project. His role included supporting technical execution, validating the findings, and reviewing the manuscript for academic quality and consistency. His inclusion in this publication acknowledges his significant contributions to the research processes.

- *Obisesan Racheal Oyeranti:*

Also served as a **Technical Crew Member**, assisting with the practical execution of the design and construction phases. She provided valuable technical assistance in ensuring the proper assembly and functionality of the projector. Her inclusion in the publication is a recognition of her important role in the research's technical success.

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