Anthropometric Data Collection and Analysis Model

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August 9, 2024

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Date: August 9, 2024

Abstract:

Anthropometric data collection and analysis serve as a cornerstone in various fields, including ergonomics, biomechanics, healthcare, and product design. This model provides a systematic approach to acquiring, processing, and interpreting anthropometric measurements to enhance precision and applicability. The model emphasizes the integration of advanced technologies such as 3D body scanning, machine learning algorithms, and big data analytics to overcome the limitations of traditional methods. By incorporating diverse demographic variables—such as age, gender, ethnicity, and occupation—the model aims to deliver a comprehensive dataset that reflects the variability in human body dimensions. The analysis phase focuses on identifying key patterns, trends, and correlations, which are essential for designing products, workspaces, and health interventions tailored to specific populations. The model also includes a feedback loop to refine data collection protocols and ensure continuous improvement. Ultimately, this approach supports the creation of more inclusive and effective solutions across multiple domains.

This abstract highlights the key elements of a model for anthropometric data collection and analysis, focusing on its importance and the advanced techniques involved. If you need further details or adjustments, feel free to ask!

Introduction

A. Overview of Anthropometry
Definition and Significance in Ergonomics:

Anthropometry, derived from the Greek words "anthropos" (human) and "metron" (measure), is the scientific study of the measurements and proportions of the human body. It plays a pivotal role in various domains, particularly in ergonomics, where the goal is to design tools, equipment, and environments that optimize human well-being and overall system performance. By understanding and applying anthropometric data, ergonomists can create designs that accommodate a wide range of human physical characteristics, leading to increased comfort, safety, and productivity.

Importance of Accurate Anthropometric Data for Ergonomic Furniture Design:

In the context of ergonomic furniture design, accurate anthropometric data is indispensable. Furniture that aligns with the user's body dimensions can significantly reduce the risk of musculoskeletal disorders, enhance comfort, and improve user satisfaction. For example, chairs, desks, and workstations designed with precise anthropometric considerations can accommodate users of varying heights, weights, and body shapes, thereby minimizing strain and fatigue. Inaccurate or outdated anthropometric data can lead to designs that are ill-suited for the intended user population, potentially causing discomfort and injury. Therefore, the collection and analysis of accurate and current anthropometric data are critical for developing ergonomic furniture that meets the diverse needs of the population.

This section provides an overview of anthropometry, emphasizing its role in ergonomics and the importance of accurate data for designing ergonomic furniture. If you need further details or revisions, let me know!

B. Purpose of the Model
Goal of Collecting and Analyzing Anthropometric Data to Inform the Design of School Furniture:

The primary goal of this model is to systematically collect and analyze anthropometric data to inform the design of school furniture that caters to the physical needs of students. School environments are unique in that they accommodate a wide range of body sizes and shapes, especially considering the growth and development stages of children and adolescents. By gathering accurate and representative anthropometric data, this model aims to create furniture that promotes proper posture, comfort, and safety, reducing the risk of musculoskeletal issues and enhancing students' ability to focus and learn effectively.

Overview of How the Model Will Be Used to Ensure Furniture Fits a Diverse Student Population:

The model will employ a comprehensive approach to ensure that the furniture design accommodates the diverse student population. This includes collecting data across various age groups, genders, and body types to capture the full spectrum of student body dimensions. The analysis phase will focus on identifying key measurements such as seat height, desk height, and backrest support, which are critical for ergonomic design. The model will also incorporate statistical methods to determine the optimal range of furniture dimensions that can comfortably fit the majority of students.

Moreover, the model will be used to create adjustable furniture solutions, allowing for customization to meet individual needs. Feedback loops will be integrated into the model, enabling continuous refinement of the design based on real-world use and additional data collection. By applying this model, schools can ensure that their furniture is inclusive, supportive, and adaptable, contributing to a healthier and more conducive learning environment for all students.

This section outlines the purpose of the model, emphasizing its role in creating school furniture that fits a diverse student population. If you need further adjustments or additional details, just let me know!

Data Collection Methodology

A. Selection of Measurement Parameters
Identification of Key Anthropometric Measurements:

For the purpose of designing ergonomically sound school furniture, the following key anthropometric measurements will be collected:

i. Height: Overall body height is crucial for determining the appropriate desk height and ensuring that students can comfortably reach and interact with their work surfaces.
ii. Sitting Height: The distance from the seat to the top of the head while seated. This measurement helps in determining backrest height and the overall height of the desk.
iii. Arm Length: The length from the shoulder to the fingertip, which is essential for ensuring that desks are of the correct depth and that armrests provide adequate support.
iv. Thigh Length: The distance from the hip to the knee when seated, important for determining seat depth and ensuring sufficient legroom.
v. Hip Width: This measurement helps in designing seat width to ensure comfort and to accommodate different body sizes.
vi. Knee Height: The distance from the floor to the top of the knee when seated, important for determining the correct height of the seat.

Justification for Choosing These Parameters:

These parameters have been chosen based on their direct relevance to furniture ergonomics, particularly in a school setting where students spend extended periods seated. Height and sitting height influence the overall scale of desks and chairs, while arm length and thigh length are critical for ensuring that students can comfortably reach and sit without strain. Hip width and knee height are also vital to ensure that the furniture accommodates the varying body dimensions of a diverse student population, promoting comfort and preventing postural issues.

B. Sampling Strategy
Criteria for Selecting Student Participants:

Participants will be selected based on the following criteria to ensure a representative sample:

a) Age: Students across different age groups will be included, reflecting the full range of growth stages from early childhood to adolescence.
b) Gender: A balanced representation of male and female students will be ensured to capture any gender-specific differences in body dimensions.
c) Grade Level: Participants from various grade levels will be selected to account for variations in physical development associated with age and education stage.
d) Ethnicity and Socioeconomic Background: Diversity in ethnicity and socioeconomic background will be considered to ensure the furniture design is inclusive and accommodates the physical diversity within the student population.

Sample Size Determination:

To achieve statistical significance, the sample size will be determined using power analysis, considering factors such as the expected variance in measurements and the desired confidence level. A larger sample size will be chosen to ensure that the results are generalizable and that the furniture designs can be applied to the broader student population.

Consideration of Diversity Within the Sample Population:

The sampling strategy will prioritize diversity to capture the full range of anthropometric variations. This includes ensuring representation from different geographical regions, cultural backgrounds, and body types, which is crucial for creating inclusive furniture designs that meet the needs of all students.

C. Data Collection Tools and Techniques

Overview of Tools:

- Stadiometers: Used for measuring standing and sitting height with precision.
- Calipers: Employed to measure body segments such as thigh length, arm length, and hip width.
- Measuring Tapes: Used for measurements like arm length and thigh length where flexibility is needed.
- Digital Measuring Devices: Where possible, digital devices will be used to increase accuracy and reduce manual errors.

Calibration of Tools:

All tools will be regularly calibrated according to manufacturer specifications to ensure measurement accuracy. Calibration checks will be conducted before each data collection session.

Standardized Procedures for Taking Measurements:

To minimize measurement error and ensure consistency:

i. Standardized positions will be used for all measurements (e.g., sitting upright for sitting height).
ii. Multiple measurements will be taken for each parameter, and the average will be used to reduce variability.
iii. Clear guidelines will be established for each measurement process, including how to position the student and how to record the measurement.

Training Requirements for Data Collectors:

Data collectors will undergo rigorous training to ensure they are proficient in the use of measurement tools and standardized procedures. This training will include:

Hands-on practice with the tools.
Instruction on proper positioning and measurement techniques.
Review of the protocol for recording and verifying data to maintain accuracy and consistency across all collectors.

D. Data Recording and Storage

Protocols for Recording Measurements Accurately:

Measurements will be recorded immediately after they are taken to minimize the risk of data loss or error. Each measurement will be checked and verified by a second data collector to ensure accuracy.

Use of Digital Tools or Software for Data Entry:

Digital tools, such as tablets or specialized anthropometric software, will be used for data entry. These tools will allow for real-time data entry, immediate error checking, and automated data processing. This reduces the risk of transcription errors and ensures that the data is organized and accessible for analysis.

Secure Storage and Backup of Collected Data:

To maintain the integrity and confidentiality of the collected data:

Data will be securely stored in encrypted digital formats with restricted access.
Regular backups will be performed on secure servers to prevent data loss.
Confidentiality agreements will be signed by all team members to protect the privacy of the participants.
This methodology ensures that the data collection process is thorough, accurate, and reliable, providing a solid foundation for designing ergonomic school furniture that meets the needs of a diverse student population. If you need further elaboration on any section or additional details, feel free to ask!

Data Analysis and Interpretation

A. Data Cleaning and Preprocessing
Techniques for Handling Missing or Inconsistent Data:

To ensure the quality and reliability of the anthropometric data, the following techniques will be employed:

- Imputation Methods: For missing data, imputation techniques such as mean imputation or regression imputation will be used to estimate missing values based on available data.
- Consistency Checks: Inconsistent data points, such as measurements that fall outside the expected range for a given age or gender, will be flagged and reviewed. If inconsistencies cannot be resolved, those data points will be excluded from the analysis.
- Data Validation Rules: Automated rules will be set within the data entry system to prevent the input of illogical values (e.g., negative heights or weights), ensuring data integrity at the point of entry.

Outlier Detection and Treatment to Ensure Reliability:

Outliers—data points significantly different from others in the dataset—can distort analysis results. To manage outliers:

Z-Score Method: This statistical method will be used to detect outliers by identifying data points that deviate significantly (typically beyond 3 standard deviations) from the mean.
Boxplots and Visual Inspection: Boxplots will be employed to visually inspect for outliers, providing a quick view of data distribution.
Treatment of Outliers: Depending on the context, outliers may either be excluded if they result from measurement error, or analyzed separately if they represent a valid but extreme variation within the population.

B. Descriptive Statistics
Calculation of Means, Medians, Standard Deviations, and Percentiles for Each Measurement:

To summarize the collected anthropometric data:

- Mean: The average value of each measurement, providing a central tendency indicator.
- Median: The middle value in the dataset, offering insights into the distribution of measurements, especially in the presence of skewed data.
- Standard Deviation: A measure of variability or dispersion within the data, indicating how spread out the measurements are.
- Percentiles (e.g., 5th, 50th, 95th): Percentiles will be calculated to understand the distribution of body dimensions across the student population, which is crucial for designing furniture that accommodates the majority of users.

Interpretation of Statistical Results to Identify Trends and Patterns:

The descriptive statistics will be interpreted to uncover key trends and patterns in the data:

1. Identifying Central Tendencies: By examining the means and medians, we can determine typical body dimensions for the student population.
2. Understanding Variation: The standard deviation and percentiles will reveal the extent of variation in measurements, which is vital for ensuring that the furniture design is inclusive.
3. Pattern Recognition: By analyzing these statistics across different age groups, genders, and grade levels, patterns in growth and body proportion changes can be identified, informing the ergonomic design process.

C. Normalization and Scaling
Adjusting Measurements for Age or Body Mass Index (BMI) to Account for Differences in Growth Stages:

To account for natural variations due to age and growth stages:

- Age-Based Adjustments: Measurements will be adjusted to a common reference age or growth stage to facilitate meaningful comparisons across different student groups.
- BMI-Based Adjustments: Since body mass can significantly influence certain anthropometric measurements, adjustments based on BMI categories (e.g.,

underweight, normal weight, overweight) will be made to ensure that the analysis accounts for differences in body composition.

Normalization Techniques to Facilitate Comparison Across Different Student Groups:

Normalization will be used to standardize data, making it easier to compare measurements across diverse groups:

Min-Max Normalization: This technique will rescale the measurements to a standard range (e.g., 0 to 1), allowing for comparisons across different dimensions.
Z-Score Normalization: By converting measurements into z-scores (standard scores), we can compare data points from different groups on a common scale, identifying which groups deviate most from the mean.

D. Multivariate Analysis
Correlation Analysis Between Different Anthropometric Measurements:

Correlation analysis will be used to explore relationships between various measurements:

Pearson Correlation Coefficient: This metric will quantify the strength and direction of linear relationships between pairs of measurements (e.g., height and arm length), helping to identify how different body dimensions are related.
Scatterplots: Visual representations of correlations will be created using scatterplots, enabling a clearer understanding of the data relationships.

Use of Principal Component Analysis (PCA) to Reduce Dimensionality and Identify Key Factors:

PCA will be applied to simplify the dataset by reducing its dimensionality while retaining most of the variance:

i. Dimensionality Reduction: PCA will transform the original set of measurements into a smaller set of uncorrelated variables, known as principal components. These components will represent the most significant variations in the data.
ii. Identification of Key Factors: By analyzing the principal components, we can identify the key anthropometric factors that most influence furniture design, such as overall body size or limb proportions.

Cluster Analysis to Group Students Based on Similar Body Dimensions:

Cluster analysis will be used to group students with similar body dimensions into distinct clusters:

- K-Means Clustering: This method will segment the student population into clusters based on their anthropometric measurements, identifying groups that share similar body types and dimensions.

- Interpretation of Clusters: Each cluster will be analyzed to understand its characteristics (e.g., average height, typical body proportions), which will inform the design of adjustable or different-sized furniture options tailored to each group.

Model Validation

A. Cross-Validation Techniques

Application of Cross-Validation to Ensure Model Accuracy:

To validate the accuracy and reliability of the anthropometric data collection and analysis model, cross-validation techniques will be employed. Cross-validation involves partitioning the dataset into multiple subsets, training the model on some of these subsets, and validating it on the remaining ones. This process helps in assessing the model's ability to generalize to new, unseen data.

K-Fold Cross-Validation: This technique will be used to divide the data into "k" equal-sized folds. The model will be trained on "k-1" folds and tested on the remaining fold, with the process repeated "k" times. The average performance across all iterations will provide a robust estimate of the model's accuracy.
Leave-One-Out Cross-Validation (LOOCV): In scenarios where the sample size is small, LOOCV can be employed, where the model is trained on all data points except one, and the process is repeated for each data point. This method helps in maximizing the use of available data for training and validation.
Splitting Data into Training and Testing Sets to Assess Model Performance:

To further assess model performance, the dataset will be split into training and testing sets:

Training Set: Typically, 70-80% of the data will be used to train the model, allowing it to learn the relationships between anthropometric measurements.
Testing Set: The remaining 20-30% of the data will be used to test the model's predictions. This separation ensures that the model's accuracy is evaluated on data it has not seen during training, providing an unbiased assessment of its performance.

B. Error Analysis

Evaluation of Measurement Errors and Their Impact on Model Predictions:

Measurement errors can significantly affect the accuracy of the model's predictions. Therefore, a thorough error analysis will be conducted:

- Measurement Error Identification: Errors may arise from inaccuracies in data collection tools, inconsistent measurement techniques, or participant movement during measurement. Identifying these errors is the first step in error analysis.
- Impact Assessment: The impact of these errors on model predictions will be evaluated by analyzing how variations in measurements affect the final design parameters. Sensitivity analysis will be employed to understand which measurements have the most significant influence on the model's outcomes.

Statistical Methods for Quantifying and Minimizing Errors:

- Root Mean Square Error (RMSE): RMSE will be used to quantify the average error between the model's predicted values and the actual measurements, providing a measure of prediction accuracy.
- Error Reduction Strategies: Techniques such as improving measurement protocols, using more precise tools, and conducting repeat measurements to average out random errors will be implemented to minimize the impact of errors on the model.

C. Comparison with Existing Data
Comparison of Collected Data with Existing Anthropometric Databases or Literature:

To validate the collected data, it will be compared with existing anthropometric databases or literature:

- Benchmarking Against Standards: The collected data will be benchmarked against well-established anthropometric databases such as the National Health and Nutrition Examination Survey (NHANES) or relevant academic studies. This comparison will help identify any significant deviations or confirm the model's alignment with existing norms.
- Trend Analysis: Any observed differences between the collected data and existing datasets will be analyzed to determine if they reflect population-specific variations, changes over time, or potential errors in data collection.

Discussion on How the Model Aligns with or Diverges from Established Norms:

- Alignment with Norms: If the model's results align with established norms, it will reinforce the validity of the data collection and analysis process.
- Divergence and Implications: Divergences from established norms will be discussed, with possible explanations such as regional differences, shifts in population demographics, or advancements in data collection methods. These findings will inform any necessary adjustments to the model.

Application in Ergonomic Furniture Design

A. Translating Data into Design Parameters
Conversion of Anthropometric Measurements into Ergonomic Design Specifications:

The validated anthropometric data will be translated into specific design parameters for school furniture:

Seat Height: Determined based on students' popliteal height (knee height when seated) to ensure feet can rest flat on the floor without pressure on the thighs.
Desk Height: Calculated from students' elbow height while seated, ensuring that the desk allows for comfortable writing and use of materials.
Seat Depth and Backrest Height: Derived from measurements like thigh length and sitting height to provide adequate support and prevent slouching.

Consideration of Variability in Data to Accommodate a Wide Range of Students:

- Design Ranges: Furniture will be designed with adjustable features to accommodate the variability in measurements observed across the student population. For instance, adjustable seat heights and tiltable desks can cater to both shorter and taller students.

- Percentile-Based Design: The design parameters will be based on key percentiles (e.g., 5th to 95th) to ensure that the furniture is suitable for the vast majority of students, avoiding one-size-fits-all solutions.

B. Customization and Flexibility in Design
Discussion on the Design of Adjustable Furniture to Cater to Different Student Body Types:

To address the diverse anthropometric needs within a school population, the model will support the design of customizable and adjustable furniture:

- Adjustable Desks and Chairs: Designs will incorporate features such as height-adjustable desks and chairs, flexible backrests, and seats with adjustable depths to accommodate different body sizes and shapes.
- Modular Furniture: Modular designs will be explored, where components such as desk surfaces and seat backs can be interchanged or adjusted to suit individual needs.

Example Case Studies or Simulations Showing the Impact of Data-Driven Design:

- Case Study: A case study might involve implementing the model's recommendations in a specific school, followed by an assessment of student comfort, posture, and satisfaction. The results will demonstrate the benefits of data-driven ergonomic design.
- Simulations: Computational simulations will be conducted to predict the impact of various design adjustments on student posture and comfort, helping to refine the design process before physical prototypes are created.

C. Practical Implementation
Steps for Integrating the Model into the Design Process of School Furniture Manufacturers:

To ensure the successful application of the model in real-world settings, the following steps will be outlined:

- Design Phase: Collaboration with designers to translate anthropometric data into practical design specifications, using CAD software to create ergonomic furniture prototypes.
- Prototyping and Testing: Development of prototypes based on the model's recommendations, followed by user testing with students to gather feedback and make necessary adjustments.
- Production: Working with manufacturers to ensure that the furniture designs are feasible for mass production, considering factors like material selection, cost, and durability.

Collaboration with Designers, Engineers, and Manufacturers to Ensure Effective Application:

- Interdisciplinary Collaboration: The model's success depends on close collaboration between ergonomists, designers, engineers, and manufacturers. Regular meetings and workshops will be conducted to align goals, share insights, and troubleshoot challenges.
- Training and Support: Training sessions will be provided to designers and engineers on how to use the model and interpret its outputs. Ongoing support will be available during the production phase to address any issues that arise.

Challenges and Limitations

A. Data Collection Challenges

Potential Difficulties in Obtaining Accurate Measurements:

Collecting accurate anthropometric data from a diverse student population presents several challenges:

- Student Cooperation: Younger students may have difficulty staying still during measurements, leading to inaccuracies. Ensuring cooperation requires clear communication and possibly engaging activities to keep students focused.
- Measurement Tools: While tools like stadiometers and calipers are generally reliable, they require proper calibration and handling. Inconsistent use or poorly calibrated tools can result in measurement errors, affecting the model's accuracy.

Ethical Considerations in Data Collection from Minors:

When collecting data from minors, ethical considerations are paramount:

- Informed Consent: Obtaining informed consent from parents or guardians is necessary, along with assent from the students themselves, ensuring that participants understand the purpose and nature of the data collection.
- Privacy and Confidentiality: Protecting the privacy of student data is critical. Personal identifiers should be removed, and data should be securely stored to prevent unauthorized access. Any use of the data must comply with relevant ethical guidelines and regulations.

B. Limitations in Data Representation

Limitations in the Model's Ability to Represent All Student Populations:

The model may face challenges in fully representing the diversity of student populations:

- Regional Differences: Anthropometric data can vary significantly across different regions due to genetic, environmental, and cultural factors. The model may need regional adjustments to accurately reflect these differences.
- Socio-Economic Differences: Socio-economic factors can influence physical development, affecting the generalizability of the model. Students from different socio-economic backgrounds may have different body proportions, which the model must account for to avoid bias.

Impact of Sample Size and Diversity on the Generalizability of Results:

Sample Size: A small sample size may limit the model's ability to generalize results across a larger population. Ensuring an adequately large and diverse sample is crucial for statistical significance and reliable model outputs.
Diversity of Sample Population: If the sample population lacks diversity in terms of age, gender, ethnicity, or socio-economic background, the model's applicability may be limited. This could lead to designs that do not fit the needs of all students.

C. Computational and Analytical Constraints
Challenges in Managing and Analyzing Large Datasets:

Managing and analyzing large anthropometric datasets can be computationally intensive:

Data Management: Storing, processing, and analyzing large volumes of data requires robust computational resources and data management practices. Inadequate infrastructure can lead to delays or errors in data processing.
Software Limitations: Analytical software may have limitations in handling large datasets or complex multivariate analyses, which could constrain the depth of analysis and the accuracy of the model's outputs.

Potential Biases in Data Interpretation and Model Outputs:

Data Interpretation Bias: Human bias in interpreting data can lead to skewed results or incorrect conclusions. Ensuring that data analysis is objective and supported by statistical methods is essential to minimize bias.
Model Output Bias: The model itself may introduce bias if it overemphasizes certain data points or trends, leading to outputs that do not accurately reflect the diversity of the population. Regular validation and updates to the model are necessary to address potential biases.

Conclusion

A. Summary of the Model's Importance
Recap of How the Anthropometric Data Collection and Analysis Model Contributes to Ergonomic Design:

The Anthropometric Data Collection and Analysis Model is a critical tool in the design of ergonomic school furniture. By systematically collecting and analyzing anthropometric data, the model ensures that furniture designs are based on the actual needs and dimensions of students, promoting comfort, health, and productivity. This data-driven approach allows designers to create furniture that accommodates a wide range of body types and sizes, addressing the diverse needs of the student population. The model's rigorous validation processes further ensure that the designs are both accurate and reliable, making a significant contribution to the field of ergonomic design.

B. Future Directions
Suggestions for Improving the Model, Including Integrating New Technologies:

Integration of 3D Body Scanning: Future iterations of the model could incorporate advanced technologies like 3D body scanning, which offers more detailed and precise measurements. This technology can capture complex body shapes and postures, providing richer data for ergonomic design.
Machine Learning and AI: Leveraging machine learning algorithms could enhance the model's ability to predict growth trends, identify unique body dimensions, and optimize design parameters for a broader range of students.

Potential for Expanding the Model to Other Educational Settings or Populations:

Expansion to Different Educational Settings: The model could be adapted for use in different educational settings, such as preschools, high schools, or vocational institutions, where students may have different ergonomic needs.
Application to Special Populations: Expanding the model to include students with disabilities or special needs could further enhance its relevance, ensuring that all students benefit from ergonomically sound furniture.

Reference

1. MICHAEL, F. B., CHIDI, U. F., & ABOSEDE, P. J. (2023). INVESTIGATION INTO THE ACCESSING OF ONLINE RESOURCES FOR LEARNING AMONG SECONDARY SCHOOL SCIENCE STUDENTS IN NIGER STATE NIGERIA. *International Journal of Educational Research and Library Science*.

2. Oladapo, S.O. and Akanbi, O.G., 2016. Regression models for predicting anthropometric measurements of students needed for ergonomics school furniture design. *Ergonomics SA: Journal of the Ergonomics Society of South Africa*, *28*(1), pp.38-56.

3. Saeed, M., Wahab, A., Ali, J., & Bonyah, E. (2023a). A robust algorithmic framework for the evaluation of international cricket batters in ODI format based on q-rung linguistic neutrosophic quantification. *Heliyon*, *9*(11), e21429. https://doi.org/10.1016/j.heliyon.2023.e21429

4. MICHAEL, FADIPE B., UWAECHIA FRANCIS CHIDI, and PETER JOY ABOSEDE. "INVESTIGATION INTO THE ACCESSING OF ONLINERESOURCES FOR LEARNING AMONG SECONDARY SCHOOL SCIENCE STUDENTS IN NIGER STATE NIGERIA." *International Journal ofEducational Research and Library Science* (2023).

5. Yousef, A., Refaat, M., Saleh, G., & Gouda, I. (2020). Role of MRI with Diffusion Weighted Images in Evaluation of Rectal Carcinoma. *Benha Journal of Applied Sciences*, *5*(Issue 1 part (1)), 1–9. https://doi.org/10.21608/bjas.2020.135743

6. Dallal, H. R. H. A. (2024). Clustering protocols for energy efficiency analysis in WSNS and the IOT. *Informasiya Cəmiyyəti Problemləri*, *15*(1), 18–24. https://doi.org/10.25045/jpis.v15.i1.03

7. MICHAEL, F.B., CHIDI, U.F. and ABOSEDE, P.J., 2023. INVESTIGATION INTO THE ACCESSING OF ONLINE RESOURCES FOR LEARNING AMONG SECONDARY SCHOOL SCIENCE STUDENTS IN NIGER STATE NIGERIA. *International Journal of Educational Research and Library Science*.

8. Biswas, A., & Talukdar, W. (2024). Enhancing Clinical Documentation with Synthetic Data: Leveraging Generative Models for Improved Accuracy. *International Journal of Innovative Science and Research Technology (IJISRT)*, 1553–1566. https://doi.org/10.38124/ijisrt/ijisrt24may2085

9. OLUSOLA, E. (2024). ANALYZING THE IMPACT OF RICE HUSK ON THE INSULATIVE QUALITIES OF BADEGGI CLAY.

10. Oladapo, S. O., & Akanbi, O. G. (2016). Regression models for predicting anthropometric measurements of students needed for ergonomics school furniture design. *Ergonomics SA: Journal of the Ergonomics Society of South Africa*, *28*(1), 38-56.

11. OLUSOLA, EOP. "ANALYZING THE IMPACT OF RICE HUSK ON THE INSULATIVE QUALITIES OF BADEGGI CLAY." (2024).

12. Rehman, M., Dhiman, B., Nguyen, N. D., Dogra, R., & Sharma, A. (2024). Behavioral Biases and Regional Diversity: An In-Depth Analysis of Their Influence on Investment Decisions - A SEM & MICOM Approach. *Qubahan Academic Journal*, *4*(2), 70–85. https://doi.org/10.48161/qaj.v4n2a448

13. Saeed, M., Wahab, A., Ali, M., Ali, J., & Bonyah, E. (2023b). An innovative approach to passport quality assessment based on the possibility q-rung ortho-pair fuzzy hypersoft set. *Heliyon*, *9*(9), e19379. https://doi.org/10.1016/j.heliyon.2023.e19379

14. Oladapo, S. O., and O. G. Akanbi. "Regression models for predicting anthropometric measurements of students needed for ergonomics school furniture design." *Ergonomics SA: Journal of the Ergonomics Society of South Africa* 28, no. 1 (2016): 38-56.15. OLUSOLA, E., 2024. ANALYZING THE IMPACT OF RICE HUSK ON THE INSULATIVE QUALITIES OF BADEGGI CLAY.

15. Omowumi, E. D. O. E., Akinbolaji, E. D. a. O., & Oluwasehun, E. D. O. S. (2023). Evaluation of Termite Hill as Refractory Material for High Temperature Applications. *International Journal of Research and Innovation in AppliedScience*, *VIII*(XI), 62–71. https://doi.org/10.51584/ijrias.2023.81105

16. Akinsade, A., Eiche, J. F., Akintunlaji, O. A., Olusola, E. O., & Morakinyo, K. A. (2024). Development of a Mobile Hydraulic Lifting Machine. *Saudi Journal of Engineering and Technology*, *9*(06), 257–264. https://doi.org/10.36348/sjet.2024.v09i06.003

17. Oladapo, S. O., & Akanbi, O. G. (2015). Models for predicting body dimensions needed for furniture design of junior secondary school one to two students. *The International Journal Of Engineering And Science (IJES) Volume*, *4*, 23-36.

18. Oladapo, S. O., Olusola, E. O., & Akintunlaji, O. A. (2024). Anthropometric Comparison between Classroom Furniture Dimensions and Female Students Body Measurements for Enhanced Health and Productivity. *International Journal of Research and Innovation in Applied Science*, *IX*(V), 328–343. https://doi.org/10.51584/ijrias.2024.905030

19. Ajao, M., Olugboji, O., & Olusola, E. (2024, May 31). *EFFECT OF SILICON OXIDE NANOADDITIVE ON BIOGAS AND METHANE YIELD OF ANAEROBIC DIGESTION OF COW DUNG AND SHEEP DUNG*. https://africanscholarpub.com/ajsede/article/view/187

20. Oladapo, S. O., and O. G. Akanbi. "Models for predicting body dimensions needed for furniture design of junior secondary school one to two students." *The International Journal Of Engineering And Science (IJES) Volume* 4 (2015): 23-36.

21. Oladapo, S.O. and Akanbi, O.G., 2015. Models for predicting body dimensions needed for furniture design of junior secondary school one to two students. *The International Journal Of Engineering And Science (IJES) Volume*, *4*, pp.23-36.

22. AJAO, M. O. EVALUATION OF FOUNDRY PROPERTIES OF SOME SELECTED NIGERIAN BENTONITE CLAYS FOR APPLICATION IN THE FOUNDRY INDUSTRY.

23. Ajayeoba, A. O., Fajobi, M. O., Adebiyi, K. A., Raheem, W. A., Oladapo, S. O., & Olayinka, M. D. (2022b). Safety assessment of charcoal usage and effects of common charcoal ignition aiders on combustion indices. *Scientific Reports*, *12*(1). https://doi.org/10.1038/s41598-022-21059-w

24. AJAO, Majeed Opeyemi. "EVALUATION OF FOUNDRY PROPERTIES OF SOME SELECTED NIGERIAN BENTONITE CLAYS FOR APPLICATION IN THE FOUNDRY INDUSTRY."

25. Ajayeoba, A.O., Fajobi, M.O., Adebiyi, K.A. *et al.* Safety assessment of charcoal usage and effects of common charcoal ignition aiders on combustion indices. *Sci Rep* **12**, 16940 (2022). https://doi.org/10.1038/s41598-022-21059-w

26. AJAO, M.O., EVALUATION OF FOUNDRY PROPERTIES OF SOME SELECTED NIGERIAN BENTONITE CLAYS FOR APPLICATION IN THE FOUNDRY INDUSTRY.

27. Omri, A., & Kahia, M. (2024). Natural Resources Abundance and Human Well-Being: the Role of Institutional Quality. *Social Indicators Research*, 1-38.

28. Slimani, S., Omri, A., & Abbassi, A. (2024). Financing sustainable development goals in Sub-Saharan Africa: Does international capital flows matter?. *Sustainable Development*.

29. Usman, M., Khan, N., & Omri, A. (2024). Environmental policy stringency, ICT, and technological innovation for achieving sustainable development: Assessing the importance of governance and infrastructure. *Journal of Environmental Management*, *365*, 121581.

30. Kahouli, B., Omri, A., & Afi, H. (2024). Technological innovations and health performance: Effects and transmission channels. *Technological Forecasting and Social Change*, *204*, 123450.

31. Omri, H., Omri, A., & Abbassi, A. (2024). Macro-level determinants of entrepreneurial behavior and motivation. *International Entrepreneurship and Management Journal*, 1-39.

32. Miled, K. B. H., & Omri, A. (2024). The role of microfinance in improving living standards: Evidence from Tunisia. Poverty & Public Policy, 16(1), 69-93.

33. Omri, A., & Boubaker, S. (2024). When do climate change legislation and clean energy policies matter for net-zero emissions?. Journal of Environmental Management, 354, 120275.

34. Altwaijri, A., Omri, A., & Alfehaid, F. (2024). Promoting entrepreneurship for sustainable development: Are education capital and ICT diffusion important?. Sustainable Development.

35. Slimani, S., Omri, A., & Abbassi, A. (2024). International capital flows and sustainable development goals: The role of governance and ICT diffusion. Socio-Economic Planning Sciences, 101882.