THE POTENCY OF AI IN WALL CRACK DETECTION AND SUSTAINABLE REMEDIES AGAINST FUTURE STRUCTURAL DAMAGE

By

AKPAN, Boniface Ekarika,
Department of Consultancy Unit.
Federal polytechnic shendam, Plateau State,

ARC. AKWAOWO, Dianabasi Reuben, Ph.D. MNIA,

UMOH, Ekerete Udo
Department of Architecture
Akwa Ibom State Polytechnic
Ikot Osura

And

Arc. Imaisong ETIM, MNIA
Misong Atelier, Oron Road, Uyo

ABSTRACT

This study examined the potency of artificial intelligence in wall crack detection and sustainable remedies against future structural damage. Descriptive survey design was adopted to carry out this research in South-South, Nigeria. The targeted population for the study comprised all architect in South-South, Nigeria. Stratified sampling technique was used to select 40 licensed architects from each of the three states in South- South (Akwa-Ibom, Rivers and Cross-River) this gave a sample size of 120 respondents used to carry out this research. The instrument used for data collection was a structured questionnaire titled "Artificial Intelligence, Wall Crack Detection and Sustainable Remedies Questionnaire (AIWCDSRQ)". Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.93, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such as descriptive statistics to answer research questions and regression analysis to test the hypothesis. The result shows that computer vision was the highest use of artificial intelligence in wall crack detection. It was also observed that computer vision and image processing was rated as the highest use of Artificial Intelligence in preventing wall crack. It also revealed that AI has a significant impact on the mitigation of future structural damage of buildings through wall crack detection and sustainable remedies. The study concluded that the application of artificial intelligence in wall crack detection marks a pivotal advancement in structural health monitoring. One of the recommendations made was that governments and construction firms should incorporate AI with real-time monitoring tools such as IoT sensors and drones to continuously assess structural health.

KEYWORDS: Artificial Intelligence, Crack Detection, Sustainable Remedies and Structural Damage

INTRODUCTION

In civil engineering and structural maintenance landscapes, the early detection of wall cracks and other forms of structural deterioration remains a critical factor in preventing catastrophic building failures. Traditionally reliant on manual inspections, this field is now witnessing a transformative shift through the integration of artificial intelligence (AI). With AI-driven systems gaining traction, engineers are not only detecting structural anomalies with greater precision but also formulating sustainable strategies for long-term infrastructure resilience (Sargiotis, 2024).

Wall cracks, often dismissed as superficial or cosmetic, are frequently the first indicators of deeper structural issues. Undetected or ignored, these cracks can compromise the integrity of buildings, leading to expensive repairs or even life-threatening collapses. Manual assessments, while foundational, are prone to human error, time-consuming, and often limited by access constraints. AI technologies such as computer vision, deep learning, and image classification algorithms offer an intelligent alternative, capable of identifying and classifying cracks with remarkable speed and accuracy (Chakurkar, Vora, Patil, Mishra, Kotecha, 2023).

One of the key strengths of AI in wall crack detection lies in its capacity to process massive volumes of visual data, learning from patterns across thousands of examples. Through convolutional neural networks (CNNs), AI models can be trained to recognise subtle fissures in a variety of building materials under diverse environmental conditions. This technological leap reduces dependency on physical inspections, allowing for remote monitoring of high-risk infrastructure and enhancing safety protocols in both urban and rural settings (Einizinab, Khoshelham, ... and Hu, 2023).

Moreover, AI's role extends beyond detection to prognosis and prevention. Predictive maintenance models powered by AI can analyse historical structural data and environmental factors to forecast the likelihood of future cracks or stress points. When integrated with Building Information Modelling (BIM) systems, AI provides a comprehensive overview of structural health, enabling stakeholders to implement eco-friendly, cost-effective remedies that align with sustainable development goals (Akbari, Sheikhkhoshkar, ... Talebi, 2024).

The integration of AI in structural health monitoring also opens new avenues for real-time decision-making. By coupling AI with Internet of Things (IoT) sensors and drones, it becomes possible to continuously monitor infrastructure with minimal human intervention. This synergy ensures not only early detection of micro-damages but also swift mitigation, thereby prolonging the lifespan of buildings and reducing the environmental impact of reconstruction and waste (Amaral, Brito, Buckman, Drake, ... & Abraham, 2020).

STATEMENT OF PROBLEM

Despite advancements in construction technology, detecting wall cracks early and accurately remains a persistent challenge. Manual inspection methods are time-consuming, prone to human error, and often overlook subtle structural faults. This delay in detection increases the risk of severe damage and costly repairs. Moreover, there is a growing need for sustainable solutions that address both current and future structural integrity. Traditional remedies often fail to consider environmental impact and long-term resilience. The integration of Artificial Intelligence (AI) presents a promising yet underutilized tool for proactive damage assessment. However, its application in sustainable crack detection and prevention is not fully explored. This study seeks to investigate the potency of AI in identifying wall cracks and proposing eco-friendly, preventive measures.

OBJECTIVES OF THE STUDY

- To find out the use of Artificial Intelligence in Wall Crack Detection
- To examine the use of Artificial Intelligence in Preventing Wall Crack
- To find out the impact of the potency of AI on the mitigation of future structural damage of buildings through wall crack detection and sustainable remedies.

RESEARCH QUESTION

- What is the use of Artificial Intelligence in Wall Crack Detection?
- What is the use of Artificial Intelligence in Preventing Wall Crack?

HYPOTHESIS

- There is no significant impact of the potency of AI on the mitigation of future structural damage of buildings through wall crack detection and sustainable remedies.

LITERATURE REVIEW

CONCEPT OF ARTIFICIAL INTELLIGENCE

Artificial intelligence is an emerging and dynamic programme that experiments with the imitation of human behaviour and intelligence by machines to lessen human workload and ensure precision. According to Francis and Chiekezi (2025), artificial intelligence (AI) is a technology that allows computers to perform tasks that typically require human intelligence. AI systems can learn from experience, adjust to new inputs, and improve over time. Lion and Ekefre (2024) cited in Akpan and Essien (2025) explained that the term artificial intelligence (AI) describes computer programs that are able to carry out sophisticated operations that were previously limited to human performance, such as problem-solving, thinking, and decision-making. The ability of a digital computer or computer-controlled robot to carry out actions typically performed by intelligent beings is known as artificial intelligence (AI).

Furthermore, Nathan and Isuaiko (2025) mentioned that artificial intelligence (AI) is the study of how the human brain makes decisions, learns new things, and thinks through difficulties. Enhancing computer skills associated with human comprehension, such as verbal intelligence, learning, reasoning, and problem-solving, is the aim of artificial intelligence. The study of artificial intelligence (AI) focusses on how the human brain solves problems, learns new things, and makes judgements. The goal of artificial intelligence is to enhance computer abilities related to human understanding, including language intelligence, learning, reasoning, and problem-solving (Akpan and Clark, 2024).

Moreover, Udo-Okon and Akpan (2024) mentioned that "a branch of computer science called artificial intelligence studies how computers learn, comprehend data, recognise characters in images, analyse pictures, and simulate how the eyes work". The study and development of computers to perform intelligence activities that call for human interaction is known as artificial intelligence. A group of technologies known as artificial intelligence allow machines to sense, understand, act, and carry out a number of tasks that are similar to those of humans. Major components of the artificial intelligence bucket are machine learning, big data, natural language processing, decision logic, data visualisation, and data analytics (Bassey and Owushi, 2023).

CONCEPT OF WALL CRACK

Wall cracks are fractures or openings that appear on the surfaces of walls due to structural stress, environmental factors, material degradation, or construction flaws. They can range from hairline fissures barely visible to the eye to larger, more severe splits that compromise the stability and integrity of a building. Wall cracks often occur as a result of foundation settlement, thermal expansion and contraction, moisture infiltration, seismic activity, or poor workmanship. While some cracks are superficial and mainly cosmetic, others can signal deeper structural problems that require immediate attention. According to Olurotimi, Yetunde and Akah (2023), cracks in the buildings develop whenever stress exceeds their strength.

The presence of wall cracks is a critical indicator of a structure's health and durability. Minor, non-structural cracks might result from natural material shrinkage as the building ages, while structural cracks typically indicate shifting foundations, overloaded walls, or serious environmental stresses. Properly diagnosing the type and cause of a wall crack is essential for implementing effective repairs and preventing future damage. Early detection and intervention are vital to maintaining the safety, functionality, and lifespan of buildings and infrastructure.

CONCEPT OF STRUCTURAL DAMAGE

Structural damage refers to any harm or impairment that affects the structural integrity, safety, and stability of a building or structure. It involves damage to load-bearing components like walls, foundations, and beams, making the structure unsafe or unsuitable for its intended purpose. Unlike cosmetic damage, which only affects appearance, structural damage compromises the building's ability to withstand loads and function as designed.

According to Durham (2025), structural damage is a legal term that encompasses the physical harm, impairments, or deterioration of a building, infrastructure, or any constructed property. Structural damage includes any damage that does adversely affect the liveability, soundness, or structural integrity of your home, including the foundation, roof, and load-bearing walls. Structural damage could mean your home is in danger of collapse or failure (Travis Central Appraisal District, 2025).

Structural damage refers to any sudden change, failure or deterioration that occurs within the components or elements of a structure, e.g., buildings or bridges. This damage can emerge due to various factors, including environmental conditions, overloading, poor construction practices, accidents, or natural disasters like earthquakes, floods, or storms. Structural damage often leads to reduced load-bearing capacity, instability, and increased risk of collapse, and hence it can compromise the stability and the safety of the affected structure. The structural damage should be identified and assessed in order to maintain the remedial measures of infrastructure. Informed decisions about necessary repairs, maintenance, or even replacement should be included to ensure the continuity of the functionality and the safety of the structure.

USE OF ARTIFICIAL INTELLIGENCE IN WALL CRACK DETECTION

Here are several artificial intelligence techniques used in wall crack detection:

- **Computer Vision:**

Computer vision allows machines to interpret and analyse visual data from images or videos (Wikipedia, 2025). In wall crack detection, high-resolution images of structures are fed into computer vision systems, which can detect, localise, and measure cracks based on patterns, contrast, and texture differences. This replaces traditional manual inspections and allows for remote, non-invasive analysis.

- **Convolutional Neural Networks (CNNs):**

CNNs are a deep learning technique specifically powerful for image recognition and classification tasks (Xiao 2024). In crack detection, CNNs are trained on thousands of annotated images of cracked and non-cracked walls. Once trained, the model can automatically classify new images, identifying the presence, type, and severity of cracks with high accuracy.

- **Edge Detection Algorithms:**
Techniques like the Canny or Sobel edge detectors are used to identify changes in pixel intensity that typically indicate the edges of cracks. These algorithms help in preprocessing images to highlight potential crack regions before further analysis using AI models (Yuan, Shi, & Li, 2024).

- **Support Vector Machines (SVM):**
SVM is a supervised machine learning algorithm used for classification and regression. In crack detection, SVM can be trained to differentiate between crack and non-crack features by analysing extracted features such as shape, size, and orientation. It is often used in combination with feature extraction methods.

- **Image Segmentation Techniques:**
Segmentation divides an image into parts for easier analysis. Techniques like semantic segmentation using deep learning help identify crack regions at the pixel level, allowing for precise mapping of crack shapes, lengths, and widths. This is useful for estimating the severity and spread of the damage.

- **Autoencoders:**
Autoencoders are unsupervised learning models used for anomaly detection. When trained on normal (non-cracked) images, they can reconstruct those images well. However, if the input has a crack, the reconstruction will fail to capture it accurately—thus highlighting anomalies as potential cracks (Zhang, Ryu, Miao, Jo, and Park, 2024).

- **Transfer Learning:**
Transfer learning uses pre-trained models like VGGNet or ResNet (trained on large datasets) and adapts them to wall crack detection with a smaller, specific dataset. This reduces the need for massive datasets and computing power, making AI deployment more accessible for smaller projects.

USE OF ARTIFICIAL INTELLIGENCE IN PREVENTING WALL CRACK

The following are the techniques that artificial intelligence (AI) can use to prevent wall cracks and ensure structural integrity:

- **Computer Vision and Image Processing:**
AI can analyse visual data from cameras and drones to detect early signs of wall cracks (Mo, Wu, & Lin, 2022). Using image classification algorithms and convolutional neural networks (CNNs), these systems can scan building surfaces for minute cracks invisible to the naked eye, helping engineers take preventive action before the damage worsens.

- **Predictive Maintenance Modelling**:
AI systems can be trained on historical structural data and environmental conditions to predict the likelihood of future wall cracks (Xu and Guo, 2025). These predictive models allow

engineers to identify stress-prone areas and intervene before any visible damage occurs, helping to extend the building's lifespan.

- **Structural Health Monitoring (SHM) with IoT Integration:**
  AI-powered SHM systems use data from IoT sensors embedded in building structures to monitor vibrations, stress, humidity, and temperature (Plevris & Papazafeiropoulos, 2024). AI algorithms analyses this data in real time to detect anomalies or predict structural weaknesses, preventing crack formation through early intervention.

- **Finite Element Analysis (FEA) with AI Optimization:**
  FEA is a computational method used in engineering to simulate how a structure behaves under various forces. When enhanced with AI, FEA becomes faster and more accurate in identifying potential stress points where cracks might form. This helps in designing more resilient structures or retrofitting existing ones.

- **Natural Language Processing (NLP) for Incident Reports**:
  AI can process textual data from inspection logs, maintenance reports, or safety audits using NLP to identify recurring patterns or risk indicators related to wall cracking. This indirect technique supports proactive maintenance planning.

- **Reinforcement Learning for Smart Construction Planning:**
  Reinforcement learning algorithms can simulate and learn the best construction practices and material usage to minimize the probability of future cracks. These algorithms help in optimizing design, construction techniques, and material selection during the planning stage.

- **3D Scanning and Deep Learning for Crack Growth Analysis:**
  Combining 3D scanning technology with deep learning allows AI to assess the depth and spread of existing cracks (Chakurkar, Vora, Patil, Mishra and Kotecha, 2023). This helps predict whether a crack is superficial or potentially structural and informs decisions on targeted repairs before further damage occurs.

- **Drone Surveillance with AI Analysis:**
  Drones equipped with AI-powered cameras can conduct aerial or vertical scans of high-rise buildings or hard-to-reach areas. This enables continuous surveillance and detection of early deformation signs, supporting quick, cost-effective maintenance.

USE OF ARTIFICIAL INTELLIGENCE TO MITIGATE STRUCTURAL DAMAGE

The following are the uses of artificial intelligence to mitigate structural damage:

- **Structural Health Monitoring (SHM) with Machine Learning:**
  Machine learning algorithms analyses real-time data from embedded sensors (e.g., strain gauges, accelerometers, and vibration sensors) in structures to monitor their health (Plevris & Papazafeiropoulos, 2024). AI can detect anomalies such as excessive stress, material fatigue, or unusual vibrations that precede structural damage. By continuously learning from the data, these

models predict potential points of failure, allowing for early intervention before serious deterioration occurs.

- **Computer Vision and Image Processing:**
  Deep learning models, especially Convolutional Neural Networks (CNNs), process images captured via drones, robots, or surveillance cameras to detect cracks, corrosion, or deformations on structural surfaces (Mo, Wu, & Lin, 2022). AI automates visual inspections by identifying fine details that human inspectors might miss. It classifies cracks based on size, shape, and severity, enabling timely and targeted repairs, which ultimately extend the lifespan of the structure.

- **Predictive Maintenance with AI:**
  Predictive algorithms use historical data on material performance, load history, and environmental conditions to anticipate future structural failures. Rather than relying on scheduled maintenance, AI predicts when and where maintenance is needed. This proactive approach minimises costs, reduces downtime, and prevents catastrophic failures by addressing issues before they become critical.

- **Finite Element Analysis (FEA) Enhancement:**
  AI improves traditional Finite Element Analysis models by speeding up simulations and enhancing accuracy through surrogate modelling and reinforcement learning. By quickly simulating how a structure reacts under various stress conditions, AI enables engineers to optimise designs for durability and predict damage patterns, supporting better construction planning and structural upgrades (Sarfarazi, Mascolo, Modano & Guarracino, 2025).

- **Natural Language Processing (NLP) for Risk Assessment:**
  AI systems use NLP to analyse technical documents, inspection reports, and maintenance logs to identify hidden patterns or overlooked risks. By mining text-based records, AI uncovers correlations between reported issues and future failures, enhancing risk prediction models and informing better maintenance strategies.

- **Digital Twin Technology:**
  AI creates and manages a real-time, virtual replica (digital twin) of the physical structure using sensor data and predictive models. Engineers can simulate various stress scenarios on the digital twin to observe potential damage developments without endangering the actual structure. This allows for dynamic assessment, better maintenance scheduling, and informed decision-making.

- **Anomaly Detection with Unsupervised Learning:**
  Using unsupervised learning methods like clustering and autoencoders, AI identifies deviations from normal behaviour without needing labelled datasets. AI can detect previously unknown or unexpected types of structural deterioration by spotting unusual sensor readings, enabling a more robust and adaptive monitoring system (Edozie, Shuaibu and Sadiq, 2025).

METHODOLOGY

Descriptive survey design was adopted to carry out this research in South-South, Nigeria. The targeted population for the study comprised all architect in South-South, Nigeria. Stratified sampling technique was used to select 40 licensed architects from three states in South- South (Akwa-Ibom, Rivers and Cross-River) this gave a sample size of 120 respondents used to carry out this research. The instrument used for data collection was a structured questionnaire titled "AI in Wall Crack Detection and Sustainable Remedies Questionnaire (AIWCDSRQ)". Face and content validation of the instrument was carried out by an expert in test, measurement, and evaluation in order to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.93, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical technique such as descriptive statistics to answer research questions and regression analysis to test the hypothesis.

RESEARCH QUESTIONS 1: The research question sought to find out the use of Artificial Intelligence in Wall Crack Detection. To answer the research question, percentage analysis was performed on the data, (see table 1).

Table 1: Percentage analysis of the use of Artificial Intelligence in Wall Crack Detection

USE	FREQUENCY	PERCENTAGE (%)
Computer Vision	28	23.33**
Convolutional Neural Networks (CNNs)	22	18.33
Edge Detection Algorithms	19	15.83
Support Vector Machines (SVM)	17	14.17
Image Segmentation Techniques	14	11.67
Autoencoders	12	10
Transfer Learning	8	6.67*
TOTAL	**120**	**100%**

** **The highest percentage frequency**
* **The least percentage frequency**
SOURCE: Field Survey

The above table 1 presents the percentage analysis of the use of Artificial Intelligence in Wall Crack Detection. From the result of the data analysis, it was observed that "Computer Vision" 28(23.33%) was the highest use of artificial intelligence in wall crack detection, while the least was "Transfer Learning" 8(6.67%). The result therefore is in agreement with the research findings of Xiao (2024), who noted that In wall crack detection, high-resolution images of structures are fed into computer vision systems, which can detect, localise, and measure cracks based on patterns, contrast, and texture differences.

RESEARCH QUESTIONS 2: The research question sought to find out the use of Artificial Intelligence in Preventing Wall Crack. To answer the research question, percentage analysis was performed on the data, (see table 2).

Table 2: Percentage analysis of the use of Artificial Intelligence in Preventing Wall Crack

USE	FREQUENCY	PERCENTAGE (%)
Computer Vision and Image Processing	25	20.83**
Predictive Maintenance Modelling	19	15.83
Structural Health Monitoring (SHM) with IoT Integration	19	15.83
Finite Element Analysis (FEA) with AI Optimisation	17	14.17
Natural Language Processing (NLP) for Incident Reports	15	12.5
Reinforcement Learning for Smart Construction Planning	13	10.83
3D Scanning and Deep Learning for Crack Growth Analysis	8	6.67
Drone Surveillance with AI Analysis	4	3.33*
TOTAL	**120**	**100%**

** **The highest percentage frequency**
* **The least percentage frequency**

The above table 2 presents the percentage analysis of the use of Artificial Intelligence in Preventing Wall Crack. From the result of the data analysis, it was observed that "Computer Vision and Image Processing" 25(20.83%) was rated as the highest use of Artificial Intelligence in Preventing Wall Crack, while "Drone Surveillance with AI Analysis" 4(3.33%) was rated the least. The result therefore is in agreement with the research findings of Mo, Wu, & Lin (2022) who quoted that AI can analyse visual data from cameras and drones to detect early signs of wall cracks.

Hypothesis One: There is no significant impact of the potency of AI on the mitigation of future structural damage of buildings through wall crack detection and sustainable remedies

Table 3:
Regression analysis of the impact of the potency of AI on the mitigation of future structural damage of buildings through wall crack detection and sustainable remedies

Model	R	R Square	Adjusted R Square	Std. error of the Estimate	R Square Change
1	0.970a^	0.941	0.940	4.677	0.941

***Significant at 0.05 level; df =118; N =120; critical r–value = 0.195**

The table shows that the calculated R-value 0.970 was greater than the critical R-value of 0.195 at 0.05 alpha level with 118 degree of freedom. The R-square value of 0.941 predicts 90% of the potency of AI on future structural damage of buildings through wall crack detection and sustainable remedies. This rate of percentage is highly positive and therefore means that there is a significant impact of the potency of AI on the mitigation of future structural damage of buildings through wall crack detection and sustainable remedies.

CONCLUSION

The application of artificial intelligence in wall crack detection marks a pivotal advancement in structural health monitoring. AI's ability to analyse vast visual data, predict future damages, and integrate with technologies like IoT and BIM enables early identification and sustainable mitigation of structural issues. This innovation reduces human error, enhances safety, and promotes eco-friendly infrastructure maintenance. The result shows that computer vision is the highest use of artificial intelligence in wall crack detection, while computer vision and image processing is rated as the highest use of Artificial Intelligence in preventing wall crack. It also revealed that AI has a significant impact on the mitigation of future structural damage of buildings through wall crack detection and sustainable remedies. As the built environment grows increasingly complex, AI offers an intelligent, proactive approach to preserving structural integrity, preventing costly failures, and extending the life of buildings. Embracing these smart systems is essential for a safer and more sustainable future in civil engineering.

RECOMMENDATIONS

- Governments and construction firms should incorporate AI with real-time monitoring tools such as IoT sensors and drones to continuously assess structural health.
- Civil engineers and infrastructure managers should implement AI-driven predictive maintenance strategies that use historical data and environmental variables to forecast potential structural issues.
- To maximise the benefits of AI in structural analysis, there should be increased investment in training professionals and upgrading digital infrastructure.

REFERENCES

Akbari, S., Sheikhkhoshkar, M., Rahimian, F. P., El-Haouzi, H. B., Najafi, M., Talebi, S. (2024). Sustainability and building information modelling: Integration, research gaps, and future directions. *Automation in Construction*, 163. https://doi.org/10.1016/j.autcon.2024.105420.

Akpan, E. E. and Clark, J. L. (2024). Artificial Intelligence: An Emerging Technology for Service and Production Enhancement in the 21st Century. *Global Academic Journal of Library and Information Science (GAJLIS),* 3(1), 63-74.

Akpan, E. E. and Essien, F. G. (2025). Artificial Intelligence: A Dependable Tool for Effective Management of Resources in Secondary Schools. *Shared Seasoned International Journal of Topical Issues*, 11(1), 119-130.

Amaral, R. E. C., Brito, J., Buckman, M., Drake, E., Ilatova, E., Rice, P., Sabbagh, C., Voronkin, S., & Abraham, Y. S. (2020). Waste Management and Operational Energy for Sustainable Buildings: A Review. *Sustainability*, 12(13), 5337. https://doi.org/10.3390/su12135337.

Bassey, M. M. and Owushi, E. (2023). Adoption of Artificial Intelligence in Library and Information Science in the 21st Century: Assessing the Perceived Impacts and Challenges by Librarians in Akwa Ibom and Rivers States. *International Journal of Current Innovations in Education*, 6 (1), 75-85.

Chakurkar, P. S., Vora, D., Patil, S., Mishra, S., and Kotecha, K. (2023). Data-driven approach for AI-based crack detection: techniques, challenges, and future scope. *Sec. Smart Technologies and Cities*, 5. Https://doi.org/10.3389/frsc.2023.1253627.

Durham, J. (2025). Structural Damage. Available at: https://joedurhampc.com/glossary/structural-damage/#:~:text=Structural%20damage%20is%20a%20legal,involved%20in%20property%2Drelated%20matters.

Edozie, E., Shuaibu, A.N., and Sadiq, B.O. (2025). Artificial intelligence advances in anomaly detection for telecom networks. *ArtifIntell Rev* 58, 100. https://doi.org/10.1007/s10462-025-11108-x.

Einizinab, S., Khoshelham, K., Winter, S., Christopher, P., Fang, Y., Windholz, E., Radanovic, M. and Hu, S. (2023). Enabling technologies for remote and virtual inspection of building work. *Automation in Construction* 156:105096. DOI:10.1016/j.autcon.2023.105096.

Francis, M. A. and Chiekezi, C. U. (2025). Adoption of Artificial Intelligence for Effective Teaching and Learning: A Panacea for Improved Academic Performance of Students Offering Economics. *International Journal of Advancement in Education, Management, Science and Technology*, 8(1), 28-38.

Mo, D. H., Wu, Y. C., & Lin, C. S. (2022). The Dynamic Image Analysis of Retaining Wall Crack Detection and Gap Hazard Evaluation Method with Deep Learning. *Applied Sciences*, 12(18), 9289. https://doi.org/10.3390/app12189289.

Nathan, N. A. and Isuaiko, O. N. (2025). Artificial Intelligence Involvement in Research Activities: Exploring its Enhancement in Researches Carried out by Post Graduate Students in Akwa Ibom State Tertiary Institutions. *GASPRO International Journal of Eminent Scholars*, 12(1), 1-13.

Olurotimi, O. J., Yetunde, O. H. and Akah, U. (2023). Assessment of the Determinants of Wall Cracks in Buildings: Investigating the Consequences and Remedial Measure for Resilience and Sustainable Development. *International Journal of Advancement in Education, Management, Science and Technology*, 6(1), 121-132.

Plevris, V., &Papazafeiropoulos, G. (2024). AI in Structural Health Monitoring for Infrastructure Maintenance and Safety. *Infrastructures*, 9(12), 225. https://doi.org/10.3390/infrastructures9120225.

Sarfarazi, S., Mascolo, I., Modano, M., & Guarracino, F. (2025). Application of Artificial Intelligence to Support Design and Analysis of Steel Structures. *Metals*, 15(4), 408. https://doi.org/10.3390/met15040408.

Sargiotis, D. (2024). Advancing Civil Engineering with AI and Machine Learning: From Structural Health to Sustainable Development. *International Journal of Architecture and Planning*, 4(2), 54-81.

Travis Central Appraisal District (2025). Non-Structural and Structural Damage. Available at: https://traviscad.org/disasters/non-structural-and-structural-damage/#:~:text=Structural%20damage%20includes%20any%20damage,danger%20of%20collapse%20or%20failure.

Udo-Okon, T. N. and Akpan, E. E. (2024). The Challenges of Artificial Intelligence in Library Management System. *Intercontinental Academic Journal of Library and Information Science*, 6(1), 96-107.

Wikipedia (2025). Computer Vision. Available at: https://en.wikipedia.org/wiki/Computer_vision

Xiao, M. (2024). CNN advancements and its applications in image recognition: A comprehensive analysis and future prospects. *Applied and Computational Engineering*, 46(1):116-124. DOI:10.54254/2755-2721/46/20241180.

Xu, G., and Guo, T. (2025). Advances in AI-powered civil engineering throughout the entire lifecycle. *Advances in Structural Engineering*. Doi:101177/13694332241307721.

Yuan, Q., Shi, Y., & Li, M. (2024). A Review of Computer Vision-Based Crack Detection Methods in Civil Infrastructure: Progress and Challenges. *Remote Sensing*, 16(16), 2910. https://doi.org/10.3390/rs16162910.

Zhang, P., Ryu, H., Miao, Y., Jo, S., and Park, G. (2024). Robust unsupervised-learning based crack detection for stamped metal products. *Journal of Manufacturing Systems*, 73, 65-74.