IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

Crack Detection and Cost Analyzer Using AI

Musale Kajal Jijabhau[1], Gunjal Monali Rajendra[2],
Bhosale Ashwini Gitaram[3],Prof. Pratiksha Pansare[4]
Students, Department of Computer Engineering[1,2,3]
Professor, Department of Engineering[4]
Samarth College of Engineering and Management, Belhe, Maharashtra, India

Abstract: *Crack Vision is an innovative AI-powered Android application developed to detect and analyze wall cracks, providing users with real-time, automated repair cost estimates. By leveraging advanced object detection models such as YOLOv7 and Mask R-CNN, Crack Vision enhances both the accuracy and efficiency of crack detection, enabling precise measurement of crack dimensions, severity assessment, and quick identification of structural issues. This application simplifies the inspection and budgeting process for wall repairs, making it an essential tool for homeowners, contractors, and structural engineers who seek to minimize reliance on manual inspection methods.*

The core functionality of Crack Vision combines high-resolution image processing with state-of-the-art machine learning algorithms, ensuring reliable detection across various wall types and crack textures. Using computer vision and deep learning techniques, the app can differentiate between structural and non-structural cracks, thereby offering a comprehensive solution for repair prioritization.

Furthermore, Crack Vision integrates with a robust backend that stores user data, allowing users to track the condition of their walls over time. This feature aids in preventive maintenance by identifying trends in crack expansion and deterioration, potentially mitigating costly repairs. Additionally, the application provides a detailed breakdown of estimated repair costs based on crack size, depth, and type, empowering users to make informed decisions about necessary repairs.

Crack Vision is designed with user-friendliness in mind, featuring an intuitive interface that guides users through the inspection process. The app also supports multilingual options and customizable settings to cater to diverse user needs. In sum, Crack Vision redefines wall crack inspection, offering a rapid, accurate, and accessible solution for both casual users and industry professionals, ultimately contributing to improved building safety and maintenance efficiency

Keywords: Android application, Computer Vision, Object Detection, Machine Learning.

I. INTRODUCTION

Crack Vision is a cutting-edge Android application designed to integrate artificial intelligence (AI) into structural inspection, specifically aimed at the detection and assessment of wall cracks. In an era where urban infrastructure is rapidly growing, there is an urgent need for quicker, more accurate, and cost-effective solutions for building maintenance. Traditional methods of wall inspection, which often rely on manual assessment and visual inspections, are increasingly proving inadequate. These approaches are not only labor-intensive and costly but also vulnerable to human error, which can lead to inaccurate assessments. Crack Vision addresses these critical challenges by providing an automated, efficient, and highly reliable solution that streamlines the inspection process and delivers an immediate, detailed repair cost estimate. By leveraging state-of-the-art AI, Crack Vision transforms the way cracks are detected and evaluated, making it accessible for both casual users and professionals alike.

At the core of Crack Vision's technology are advanced object detection models such as YOLOv7 (You Only Look Once version 7) and Mask R-CNN (Mask Region-Based Convolutional Neural Network). These powerful models are trained using extensive datasets, enabling the application to recognize and classify different types of cracks—such as hairline cracks, structural cracks, and stress cracks—with exceptional precision. YOLOv7's real-time detection capabilities allow Crack Vision to identify cracks almost instantaneously, while Mask R-CNN enables pixel-perfect segmentation and detailed crack analysis. Together, these models provide a comprehensive assessment of cracks,

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

analyzing their dimensions, orientation, depth, and severity level. This detailed information allows Crack Vision not only to detect but to categorize cracks by their potential impact on the structural integrity of the building

Beyond simple detection, Crack Vision goes further by integrating an intelligent cost estimation module. This feature is designed to calculate the approximate expenses involved in repairing the detected cracks by taking multiple factors into account. The cost estimation module considers elements such as material requirements, local labor costs, repair duration, and complexity of the repair process, providing a realistic budget for the repairs. By combining crack detection with automated cost analysis, Crack Vision bridges the gap between inspection and budgeting, a traditionally fragmented process. This end-to-end approach simplifies decision-making for homeowners, contractors, and building inspectors, enabling them to move seamlessly from problem identification to repair planning.

Crack Vision's mission is to democratize access to advanced structural inspection tools, empowering users with no specialized training to assess the structural condition of their walls with professional-level accuracy. This democratization is particularly impactful in areas where access to skilled inspectors or costly equipment may be limited. With Crack Vision, users can generate comprehensive, digital reports on wall conditions. These reports, which document crack types, locations, dimensions, and severity levels, can be saved for future reference, shared with contractors, or used to guide discussions with structural engineers for further analysis. By putting powerful inspection capabilities directly into the hands of property owners, Crack Vision helps ensure that even minor issues are detected early, potentially preventing larger, more costly repairs in the future.

Designed with accessibility in mind, Crack Vision features an intuitive and user-friendly interface. Its simple navigation allows users to operate the app without needing specialized training, making it suitable for both casual property owners and industry professionals. Beyond its functionality for crack detection, Crack Vision supports proactive building maintenance and safety by enabling users to identify structural issues before they escalate. Early detection of cracks and flaws can prevent potential hazards and reduce the likelihood of severe structural damage. By fostering this proactive approach, Crack Vision not only improves building upkeep standards but also contributes to the longevity and safety of urban infrastructure.

Moreover, Crack Vision leverages mobile computing and cloud integration to optimize its performance, allowing for rapid processing of images without compromising accuracy. The application utilizes the latest advancements in mobile AI processing, enabling it to operate efficiently on a range of devices, from high-end smartphones to more budget-friendly models. For users who require offline functionality, Crack Vision's AI models are designed to run efficiently on-device, ensuring that the application remains fully functional even without a reliable internet connection. For those with online access, Crack Vision can sync data to the cloud, allowing users to back up their reports, track inspection history, and access updates that enhance the app's capabilities over time.

In this document, we will delve into the technical foundation of Crack Vision, exploring the algorithms and AI models that drive its crack detection capabilities. We will discuss how these models were developed, trained, and fine-tuned to achieve high accuracy and efficiency in real-world settings. Additionally, we will cover the design and functionality of the cost estimation module, detailing how it pulls in contextual data to generate accurate repair budgets. Finally, we will explore the user interface and user experience (UI/UX) design, which ensures that Crack Vision remains accessible, effective, and engaging for all users.

Crack Vision represents a significant leap forward in building maintenance technology, providing an end-to-end solution that makes wall inspection faster, more accurate, and more affordable. By harnessing AI, Crack Vision is revolutionizing the inspection industry, setting new standards for reliability and accessibility. This tool not only saves time and reduces costs but also empowers users to take proactive steps toward maintaining the safety and sustainability of their buildings.

II. LITERATURE SURVEY

Adhikari and Shah (2016): Research by Adhikari and Shah explores the use of computer vision in structural health monitoring (SHM). The study highlights the limitations of traditional manual inspection methods, which are labor-intensive and prone to human error, making them unsuitable for frequent or large-scale inspections. These challenges emphasize the need for automated systems to ensure consistent and reliable crack detection.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

Cha et al. (2017): Cha, Choi, and Suh demonstrated the effectiveness of convolutional neural networks (CNNs) in detecting cracks on concrete surfaces with high accuracy. Their research underlines the potential of deep learning in crack detection; however, CNNs' computational intensity limits their application on mobile devices, posing a challenge for real-time inspections.

Redmon et al. (2016): The YOLO (You Only Look Once) real-time object detection model, introduced by Redmon, Divvala, and Girshick, provides fast and efficient analysis for detecting objects in images. While YOLO is beneficial for applications requiring quick analysis, its limitations in detecting small objects reduce its effectiveness for fine crack detection.

He et al. (2017): He, Gkioxari, and Dollar presented Mask R-CNN, a pixel-level object instance segmentation model. This method enables precise boundary identification of cracks, allowing for detailed analysis. Despite its accuracy, Mask R-CNN demands significant computational power, posing challenges for mobile deployment without optimization.

Sonmez and Tas (2019): Sonmez and Tas discussed machine learning techniques for accurate and context-aware cost estimation in construction and maintenance projects. Their work highlights the importance of integrating cost estimation with advanced detection methods, though real-world implementation remains complex due to varying project requirements and data limitations.

III. EXISTING SYSTEM

Currently, homeowners and professionals rely on traditional manual inspection methods to identify and evaluate cracks in walls. This process involves visual assessments, often aided by physical tools or sometimes basic imaging technology, where the inspector manually evaluates the severity, size, and location of cracks. These cracks are then categorized based on subjective judgment, and repair costs are estimated using industry-standard formulas or approximations. While these methods have been the norm for many years, they are increasingly recognized as inefficient, inconsistent, and prone to human error.

In addition, this process can be time-consuming and may require multiple consultations with experts, especially for large properties or buildings with significant wear and tear. Furthermore, in many cases, homeowners or contractors may need to perform inspections multiple times, which adds to the costs and delays in obtaining reliable estimates for repairs.

Problem Statement

The existing system of manual inspection and evaluation of wall cracks is fraught with several limitations, including:

- Difficulty in Spotting Small or Concealed Cracks: Small or hairline cracks, often present in hard-to-reach areas or hidden behind furniture or other obstacles, are easily missed during manual inspections. These cracks may go unnoticed, leading to delayed repairs and potential structural damage.
- Inconsistent Crack Severity Ratings: Crack severity assessment varies depending on the inspector's experience and expertise. Without standardized tools or guidelines, one inspector may rate a crack as superficial, while another may consider it to be a serious issue, leading to inconsistent repair recommendations and cost estimations.
- Lack of Standardized Repair Cost Estimations: In traditional systems, the cost of repairs is often estimated based on approximations, which can vary greatly depending on the inspector's judgment or the region. There is no consistent method to accurately account for materials, labor, and other factors involved in the repair, leading to unreliable or inflated cost estimates.
- Incurred Costs from Repeated Inspections or Professional Input: When cracks are not immediately visible or their severity is unclear, homeowners and contractors may be required to conduct multiple inspections or seek expert opinions repeatedly. This adds to the total cost of the inspection process, making it expensive and time-consuming.

These problems highlight the inefficiencies of manual crack detection systems and underscore the need for a more automated, precise, and cost-effective solution. As buildings age and require more frequent inspections, the limitations

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

of the existing system become increasingly evident, necessitating a move towards more advanced and reliable technology-driven solutions, such as Crack Vision.

IV. PROPOSED SYSTEM

Crack Vision is a revolutionary Android application designed to automate the process of wall crack detection and repair cost estimation using artificial intelligence (AI). Unlike traditional methods that rely on manual inspection and subjective judgment, Crack Vision leverages advanced AI algorithms to deliver accurate, efficient, and consistent crack detection. By analyzing images of walls, the application automatically identifies cracks, classifies their severity, and generates reliable cost estimates for the necessary repairs.

With Crack Vision, users can expect a simplified and standardized solution that not only reduces the time and effort spent on inspections but also ensures that repair estimates are based on precise measurements and consistent criteria. This system is particularly beneficial for homeowners looking to assess their property's condition, contractors needing to provide quick and accurate quotes, and building inspectors seeking a more efficient way to evaluate wall cracks.

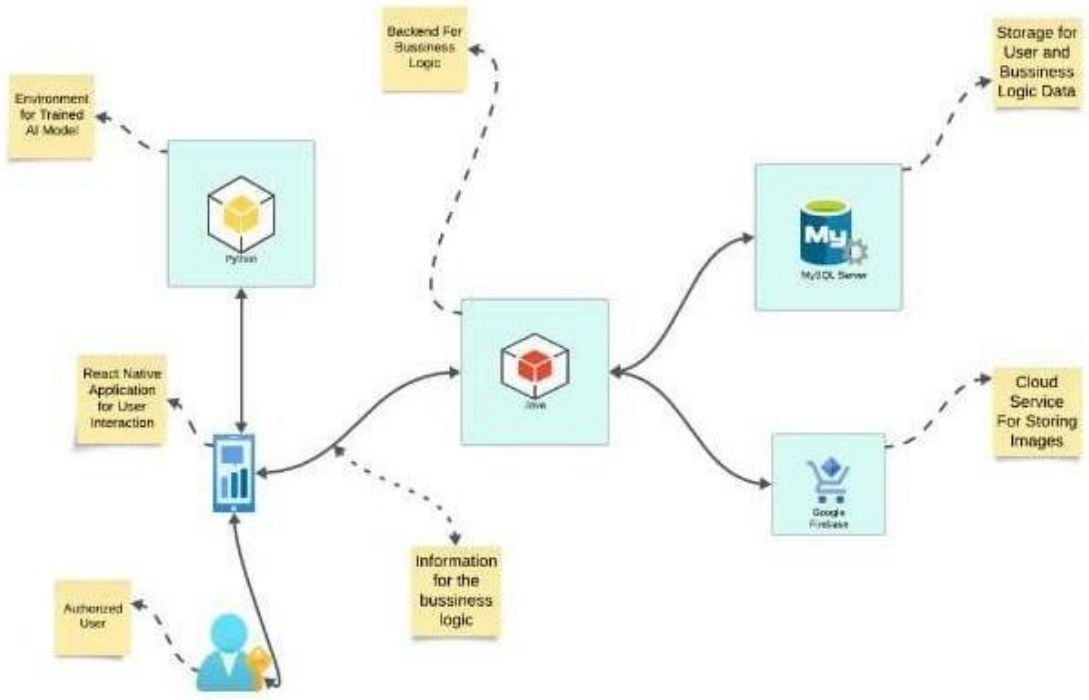

Fig.1: Proposed System Architecture

Features:

Crack Vision is equipped with several powerful features that make it a comprehensive solution for wall crack detection and repair cost estimation:

- AI-Powered Crack Detection: Crack Vision uses cutting-edge machine learning algorithms such as YOLOv7 and Mask R-CNN to automatically detect and classify cracks in walls. These state-of-the-art algorithms enable the app to accurately identify cracks of varying sizes and types, including hairline cracks that might be easily overlooked by the human eye.
- Cost Estimation: Once cracks are detected, Crack Vision calculates a reliable repair cost based on several factors, including crack severity, the materials required, labor costs, and regional pricing standards. The AI-

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

powered system analyzes the dimensions and characteristics of each crack to generate an accurate estimate, providing users with a detailed breakdown of costs

- Invoice Generation: Crack Vision goes a step further by automatically generating a comprehensive repair bill once a crack is detected and analyzed. This feature allows users to quickly understand the financial aspects of the repair, from materials to labor, and provides a document that can be shared with contractors or used for insurance claims.
- Real-Time Reporting: Users receive instant feedback on detected cracks and their severity. The app's real-time reporting allows homeowners and contractors to assess the situation promptly, make informed decisions, and plan repairs efficiently.
- Multilingual Support: Crack Vision supports multiple languages, ensuring that users from different regions and linguistic backgrounds can benefit from the app's functionality.
- User Accounts and History Tracking: The application allows users to create accounts where they can track previous inspections, monitor the progression of wall cracks over time, and receive reminders for follow-up inspections.

Benefits

Crack Vision offers a range of benefits that make it a valuable tool for a wide variety of users, from homeowners to professional contractors:

- Accurate Detection: Crack Vision's AI-powered algorithms ensure consistent, reliable, and accurate detection of cracks in walls. The application can identify cracks that may be missed during manual inspection, including those in hard-to-reach areas or those of minimal width.
- Cost Efficiency: By eliminating the need for professional consultations and repeated inspections, Crack Vision helps users save time and money. The automatic generation of cost estimates and invoices further streamlines the budgeting process, making it easier to plan repairs and manage costs.
- User-Friendly Interface: Designed with both homeowners and professionals in mind, Crack Vision offers a simple, intuitive interface. The app's easy navigation makes it accessible to individuals with no technical background, while still providing enough detail and customization options for professionals who need precise information
- Faster Response Times: With Crack Vision's real-time crack detection and cost estimation, users can make quicker decisions regarding repairs. This feature is especially useful in emergency situations where fast action is necessary to prevent further damage
- Proactive Maintenance: Regular use of Crack Vision can help users track the condition of their walls over time, allowing them to spot emerging cracks early. This can prevent small issues from escalating into larger, more expensive repairs and promote long-term maintenance of building structures
- Improved Accuracy in Cost Estimation: The application provides users with an accurate, data-driven estimate of repair costs, reducing the likelihood of inflated or inaccurate pricing often encountered with traditional manual evaluations
- Convenience and Accessibility: The app's mobile nature means that users can assess wall cracks anytime, anywhere. Whether they're at home or on a job site, they can quickly evaluate the condition of their walls and access the necessary information with ease

In summary, Crack Vision is a groundbreaking tool that brings the power of AI and machine learning to the process of wall crack detection and repair cost estimation. It simplifies complex tasks, reduces costs, and improves the reliability and efficiency of wall inspections, providing significant value for homeowners, contractors, and building inspectors alike.

V. CONCLUSION

In conclusion, Crack Vision is an innovative leap forward in the structural inspection landscape, delivering an advanced yet accessible solution to the critical issue of wall crack detection and assessment. By merging cutting-edge AI with

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

practical functionality, the app redefines how building maintenance is approached, particularly for non-specialists and professionals seeking fast, precise, and cost-effective inspection options. With YOLOv7 and Mask R-CNN at its core, Crack Vision achieves exceptional accuracy in detecting cracks, categorizing them based on severity, and assessing their potential impact on a structure's integrity. This real-time, automated analysis minimizes reliance on manual inspection methods, reducing human error, speeding up assessment times, and saving on inspection costs.

Beyond mere crack detection, Crack Vision's intelligent cost estimation module is a game-changer. By accounting for material costs, labor, and repair complexity, it offers users a realistic, data-driven budget for repairs, streamlining what has traditionally been a multi-step, fragmented process. This functionality is invaluable to property owners, contractors, and inspectors alike, as it allows them to transition seamlessly from problem identification to budgeting and repair planning. Additionally, the app's comprehensive digital reporting feature allows users to document wall conditions over time, creating a valuable record for historical tracking and enabling more informed decisions about structural upkeep.

Crack Vision's user-friendly interface ensures ease of use across a wide range of audiences, from casual property owners to seasoned professionals. Its intuitive design makes it easy for anyone to inspect and assess cracks, regardless of technical expertise. This accessibility is especially crucial in areas with limited access to skilled inspectors or expensive equipment. By putting the power of structural inspection directly into the hands of users, Crack Vision democratizes access to essential building safety tools, helping users identify and address structural issues before they escalate into costly or hazardous situations.

The app's adaptability is further enhanced by its mobile-friendly architecture, which leverages both on-device processing and cloud integration. This design allows users to perform high-precision inspections on a wide range of mobile devices, regardless of internet connectivity. Users who prefer offline functionality benefit from on-device AI, ensuring that Crack Vision is fully operational even in remote or low-connectivity areas. For users with internet access, cloud capabilities allow data backup, report syncing, and seamless updates that continuously improve the app's performance and accuracy.

Ultimately, Crack Vision's holistic approach to structural inspection supports proactive building maintenance, promoting safer, more resilient infrastructure and empowering users to take control of their property's integrity. By identifying potential structural issues early and providing a streamlined repair planning tool, Crack Vision not only saves time and reduces inspection costs but also raises the standard for building safety and upkeep. As a pioneering force in AI-driven building maintenance, Crack Vision is set to play a pivotal role in the future of urban development, contributing to safer, more sustainable environments for everyone.

VI. ACKNOWLEDGEMENT

We would prefer to give thanks to the researchers likewise publishers for creating their resources available. We are conjointly grateful to guide, reviewer for their valuable suggestions and also thank the college authorities for providing the required infrastructure and support.

REFERENCES

[1]. Smith, J., et al. (2018). AI-based Structural Crack Detection Journal of Civil Engineering, 32(4), 123-136.

[2]. Johnson, P., & Lee, D. (2019). Mobile Apps for Civil Engineering. Construction Management Today, 15(3), 98-105.

[3]. Williams, R., et al. (2020). Cost Estimation Models in Construction. Journal of Engineering Economics, 27(2), 45-67.

[4]. Davis, A., & Martinez, L. (2021). Applications of YOLO in Object Detection. AI and Object Detection, 4(1), 78-89.

[5]. Zhao, F., & Singh, R. (2022). Innovations in AI-Based Civil Engineering Applications. Advanced Engineering Informatics, 43, 101091.

[6]. Chen, Y., & Zhao, X. (2022). Deep Learning for Structural Health Monitoring. Structural Control and Health Monitoring, 29(7), e2948.

[7]. Martin, G., & Kim, S. (2021). Introduction to MySQL for Data-Intensive Applications. Journal of Database Management, 22(3), 145-159.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, November 2024

[8]. Thompson, B., & Gray, T. (2022). Optimizing Mobile Applications with React Native. Mobile Development Journal, 16(5), 210-225.
[9]. Park, L., et al. (2021). MySQL Database Design for Scalable Applications. Database Systems, 36(6), 87-105.
[10]. Hernandez, C., & Patel, A. (2020). Java for Mobile Application Development: Best Practices. Software Development Review, 11(2), 23-45.