

# WALLEYE: Advanced Wall Crack Detection System

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**Abstract:** *Wall crack detection is important for checking the safety and condition of buildings. Cracks in walls can become dangerous if they are not identified at an early stage. This paper presents a machine learning-based system that automatically detects wall cracks using images and photographs. By using deep learning and computer vision techniques, the system finds cracks on wall surfaces and measures crack features such as length and width.*

*Based on the crack size, the system classifies cracks as minor, moderate, or major. Minor cracks usually occur due to plaster shrinkage and have low risk, while major cracks indicate serious structural problems. The system also determines the risk level of cracks as low, medium, or high and suggests suitable repair solutions. Minor cracks can be repaired using simple fillers, whereas major cracks require expert inspection.*

*A Python-based risk level graph is used to clearly show the relation between crack width and risk level. The results show that the proposed system provides accurate crack detection and reduces the need for manual inspection. Overall, this system is reliable, time-saving, and helpful for improving building safety and maintenance planning..*

**Keywords:** Wall Crack Detection, Machine Learning, Deep Learning, Computer Vision, Risk Analysis

## I. INTRODUCTION

Buildings are an important part of modern infrastructure, and their safety depends on regular inspection and maintenance. One common problem in buildings is the formation of **cracks in walls**. Wall cracks may occur due to factors such as **aging of structures, poor construction quality, temperature changes, earthquakes, and environmental effects**. If these cracks are **not detected early**, they can grow over time and lead to **serious structural damage**.

Traditional wall crack inspection methods mainly rely on **manual observation by engineers or workers**. These methods are **time-consuming, costly, and sometimes inaccurate**, especially for **large buildings or hard-to-reach areas**. Human inspection may also **miss small cracks at an early stage**, which increases the risk of **major damage in the future**.

To overcome these limitations, this project presents an **Advanced Wall Crack Detection System based on Machine Learning techniques**. The proposed system uses **image processing, deep learning, and computer vision to automatically detect cracks from wall images**. It also **classifies cracks as minor, moderate, or major** based on their **size and shape**.

By automating the detection and classification process, the system **reduces manual effort, improves accuracy, and enables early identification of structural problems**. This approach provides a **reliable and efficient solution for building safety monitoring and maintenance planning**.



## II. LITERATURE SURVEY

Ashok Sutagundar and Rashmi M. Kittali developed an AI-based Crack Detection and Correction System. Their system uses artificial intelligence to automatically detect wall cracks and categorize them as hairline, medium, or wide. This helps in identifying the basic severity of cracks. However, the system has limitations in detecting deeper cracks and does not provide detailed classification based on the type of crack. The ideas in this work are influenced by the principles explained in “Artificial Intelligence: A Modern Approach” by Stuart Russell and Peter Norvig.

Meenakshi Somnadh Patil and Dr. R. B. Ghongade focused on crack detection in concrete cubes using image processing and machine learning techniques. Their system improves the accuracy of material testing by identifying cracks more reliably in controlled conditions. However, it is less practical for large-scale building inspections because it depends on limited sensors and is difficult to scale. Their approach is based on concepts from “Digital Image Processing” by Rafael C. Gonzalez & Richard E. Woods and “Machine Learning” by Tom M. Mitchell.

WiwitSuksangaram and WorawutYimyam proposed a system that captures images of walls and applies advanced image processing methods to detect visible cracks. This system is particularly useful for homeowners during inspections. However, it only identifies cracks and does not classify them or detect related issues such as mold. Their work draws on techniques discussed in “Computer Vision: Algorithms and Applications” by Richard Szeliski.

## III. PROBLEM OF STATEMENT

In many buildings and industrial sites, traditional monitoring and inspection methods have several drawbacks. They often depend on manual checking, which takes a lot of time, effort, and can be prone to mistakes. These methods also cannot detect problems in real time or adjust to changing conditions. Because of this, small issues like wall cracks or other safety hazards may be missed, leading to higher maintenance costs, inefficiency, and potential risks.

Some automated systems exist, but they are limited. They often use fixed algorithms or rely on data from different sources, which can reduce their accuracy. Most of these systems also cannot classify how severe a crack is or provide clear guidance for repairs.

This project focuses on solving this problem by creating an intelligent, automated system that can monitor walls continuously, detect cracks, measure their severity, and give real-time suggestions for maintenance or repair. The system should be efficient, scalable, and reduce the need for constant human supervision, making buildings safer and maintenance easier to plan.

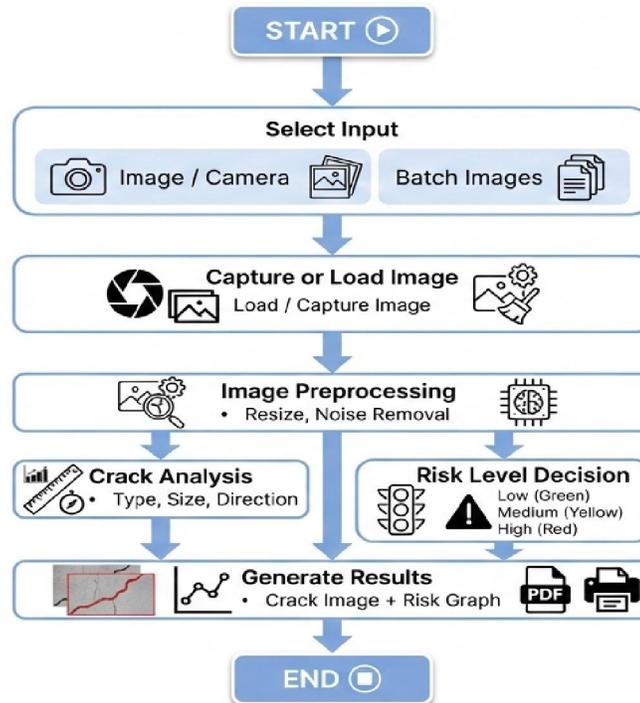
## IV. EXISTING PROBLEM

In the existing systems for wall crack detection, most inspections are carried out manually by engineers or building inspectors, who visually examine walls to identify cracks. This process is time-consuming, labor-intensive, and prone to human error, especially when cracks are small or in hard-to-reach areas. Some automated approaches have been developed using image processing techniques, such as edge detection, thresholding, and morphological operations, which can highlight cracks in wall images. However, these systems often struggle with varying lighting conditions, wall textures, and background noise, which reduces their accuracy.

Additionally, early automated methods using basic machine learning algorithms like Support Vector Machines (SVM), K-Nearest Neighbour’s (KNN), or Random Forests can detect cracks, but they require manual feature extraction and are limited in classifying crack severity. These systems also usually process pre-captured images rather than providing real-time monitoring, which makes them less effective for continuous observation. Some solutions use webcam-based applications, but they often lack deep learning models for automatic feature extraction and severity classification, making them unable to provide real-time recommendations for maintenance.



**V. PROPOSED SYSTEM**



**WALLEYE System Workflow**

**Step-by-step explanation:**

**1. Start**

The process begins when the system is launched.

**2. Select Input**

The user chooses how to provide images:

- Image/Camera: Take a photo using a camera or upload a single image.
- Batch Images: Upload multiple images at once for analysis.

**3. Capture or Load Image**

The selected image(s) are either captured in real time or loaded from storage into the system.

**4. Image Preprocessing**

Before analysis, the image quality is improved:

- Resizing: Adjusts the image size for better processing.
- Noise Removal: Removes unwanted distortions to make cracks clearer.

**5. Crack Analysis**

The system analyzes the cracks in the image by identifying:

- Type of crack
- Size (length and width)
- Direction (orientation of the crack)

**6. Risk Level Decision**

Based on the crack analysis, the system determines the risk level:

- Low (Green) – minor cracks, low risk



- Medium (Yellow) – moderate cracks, needs attention
- High (Red) – serious cracks, high risk

#### **7. Generate Results**

The final output is produced:

- An image showing detected cracks
- A risk graph for easy understanding
- Results can be saved or printed (e.g., PDF)

#### **8. End**

The process is completed after the results are generated.

### **VI. CONCLUSION**

The WALLEYE project demonstrates how Artificial Intelligence (AI), Internet of Things (IoT), and data analytics can work together to create a smart and automated monitoring system. By using a web-based GUI interface, the system allows users to monitor walls or structures remotely in real time through a web browser. The system can capture data either using a webcam for live monitoring or by analysing pre-captured images of walls, enabling flexibility in inspection.

The captured images or video frames are processed using image processing and machine learning algorithms to detect cracks or anomalies automatically. The system can measure crack length and width, classify cracks as minor, moderate, or major, and provide risk levels. Real-time alerts and recommendations are displayed on the web interface, helping users to take timely actions for maintenance or repair. Users can also view historical data, generate reports, and track trends over time, which improves long-term planning.

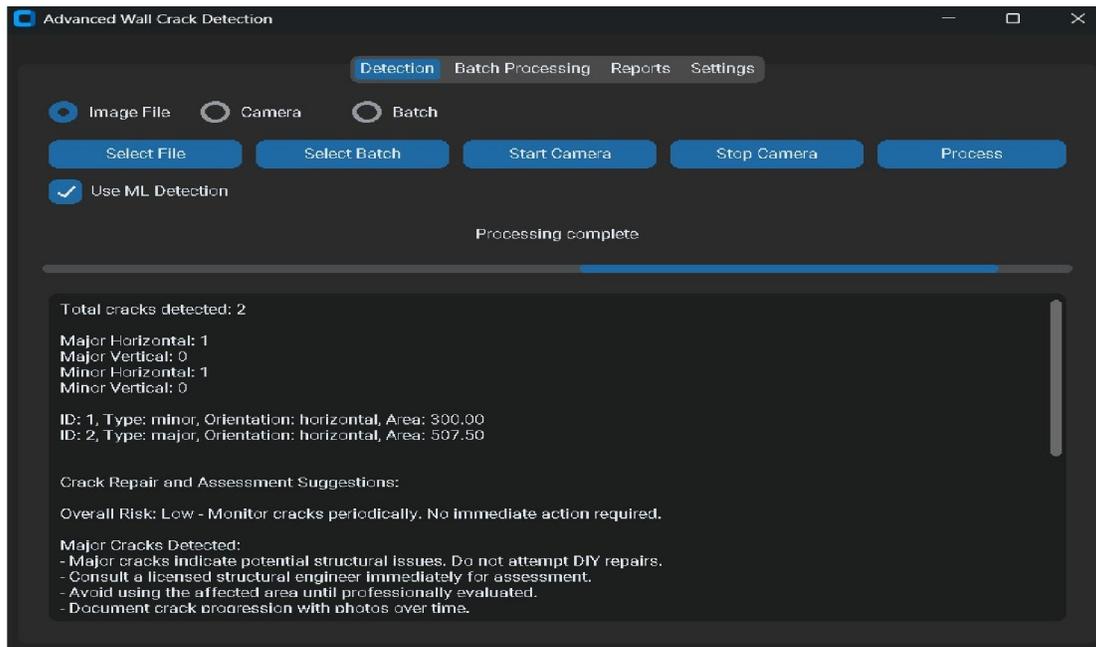
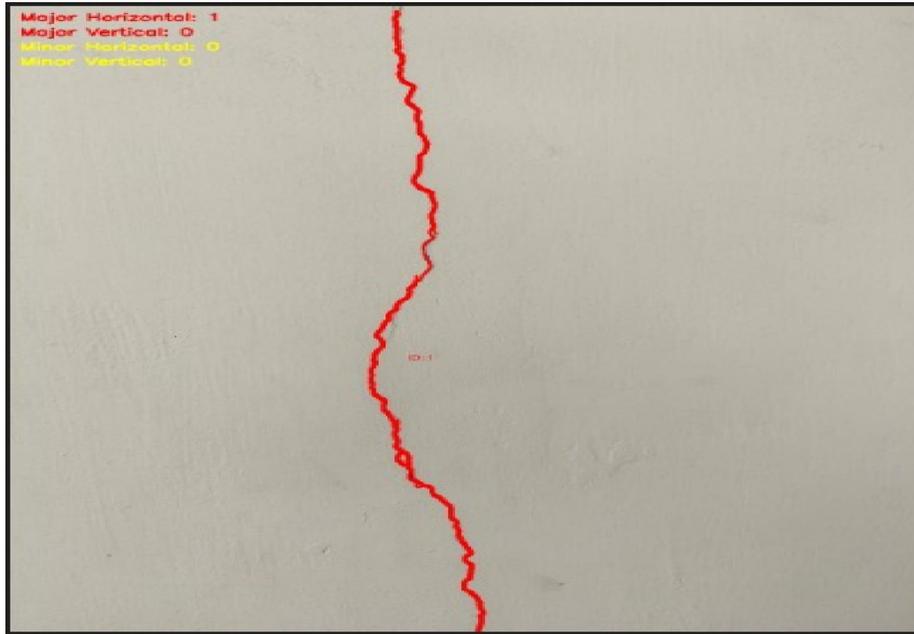
The use of a webcam or images combined with a web GUI makes the system scalable, interactive, and user-friendly. It reduces dependency on manual inspection, increases accuracy, and allows monitoring of large areas efficiently. Overall, WALLEYE provides a smart, automated, and data-driven solution for structural health monitoring, making environments safer and maintenance more efficient.

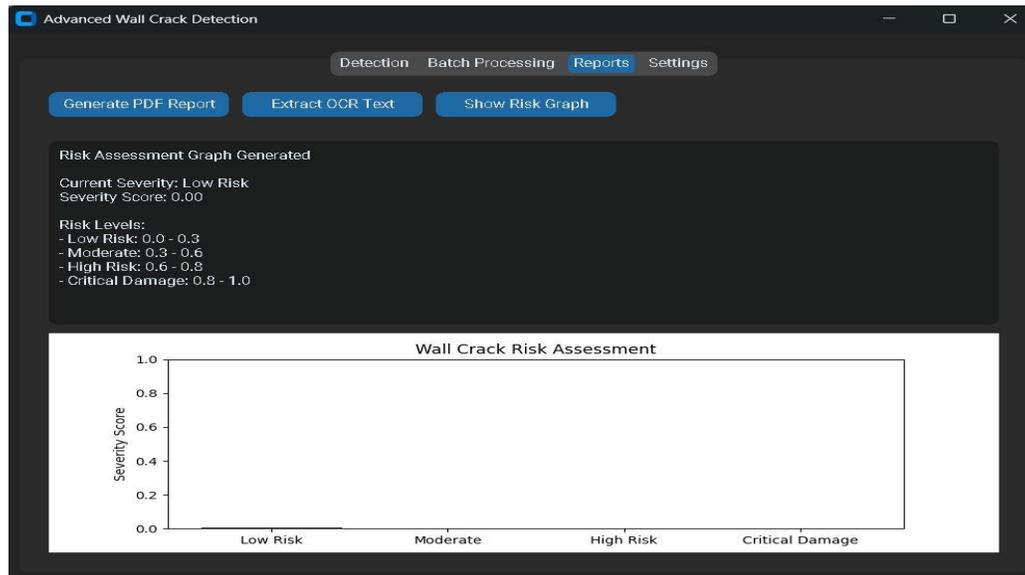
### **VII. ACKNOWLEDGMENT**

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**VIII. OUTPUT**





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