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Railway Track Fault Detection

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ABSTRACT

The digital nature of the data collection involved with a computer vision based method, archiving inspection results and trending of the data becomes feasible, leading to more advanced failure prediction models for maintenance scheduling and a more thorough understanding of railway track structure. Here a computer vision based method is presented. For better inspections and security, we need an efficient railway track crack detection system. In this project, we present a computer vision-based technique to detect the railway track cracks automatically. This system uses images captured by a rolling camera attached just below a self-moving vehicle in the railway department. The source images considered are the cracked and crack-free images. The first step is pre-processing scheme and then apply image processing. First order statistical features are extracted from the image processing and these extracted features are given as input to the deep learning neural network for differentiate the cracked track image from the non-cracked track image.

1.INTRODUCTION

The railway is the biggest means of transportation in India. Rail transportation is the utmost importance as a component of urban public transport system. Its advantages of fast, punctual and large capacity make to become the most frequent choice for urban inhabitants. However, as a high-density, high flow, and relatively enclosed public transportation system, rail transportation brings gathered a crowd when encounters the growing problem of urban traffic congestion. The operational security issues have become increasingly prominent.

Derailment happens because of weak development Crack, missing of rail route snares, helpless rail tracks and so forth extension cracks are the cracks which are intentionally near between the rail closures to take into account development of the rails in warm climate. These cracks have a favor size between the 7.5mm to 8mm and anything past that reach is consider as danger.

The states of these gaps are assessed physically by a group of railroad workers and designers going along the track. In this manner its particularly tedious and the quality, proficiency of work contrasts from one individual to another. To accelerate this cycle, to give steady great quality and to limit the human blunders this project expects to discover an answer that will screen the gaps and rail tracks quality utilizing picture handling and decide if they are in acceptable condition or not. In the initial segment, where the identification of expansion gaps. There are three fundamental strategies are image division, data extraction and afterward analysis and estimation. After that the significant thing is picture division. It's a basic measure which is used to division a picture into segment part and these ideally correspond to different actual world things.

Advancements in image processing and machine learning, particularly through the use of Convolutional Neural Networks (CNNs), have been used for automating the detection of railway track faults. This project aims to develop a robust and efficient railway track fault detection system using

image processing techniques powered by a CNN dense architecture.

Existing system

The existing system of railway track fault detection typically involves the combination of the three techniques.

Discrete Cosine Transformation (DCT): A mathematical transformation used to analyse and process image data. It transforms spatial domain information into frequency domain data, which is effective for identifying patterns and compressing images. For railway track fault detection, DCT can highlight anomalies or irregularities in images of railway tracks by focusing on the frequency components of the image.

Clustering: Groups similar data points or features extracted from the image for easier analysis by grouping parts of the track. The clustering process helps in segmenting fault and non-fault areas for further analysis.

Feature Extraction: Utilizes Gaussian methods to extract characteristics from the image data. Gaussian methods are often utilized for this purpose to extract meaningful features that can help identify faults. These features provide the basis for further classification or fault detection.

Proposed System

The proposed method leverages Convolutional Neural Networks (CNNs) to analyze captured images of railway tracks for fault detection. This automated system identifies and classifies defects like cracks and misalignments, ensuring timely maintenance and improving track safety.

Data collection: It involves deploying sensors along the railway tracks to monitor parameters such as vibration, temperature, and alignment anomalies.

Pre-processing: It involves cleaning the collected data by removing noise, outliers, and inconsistencies to ensure accurate fault prediction. The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing.

CNN: Convolutional Neural Networks (CNNs) are employed to analyze images of railway tracks, identifying surface cracks and other structural defects with high precision.

2. REQUIREMENTS ANALYSIS

Functional Requirements

Modules:

- User:

  Upload Image: Users can input their medical test values.

  View Result: It detects the risk of fault in railway track based on image.

Non - Functional Requirements

- **Security:** Implement security measures to protect users data.
- **Scalability:** It ensures the ability to handle a growing number of users and increasing data volumes.
- **Accuracy:** It achieves a high true positive rate in detecting fault cases to minimize false negatives
- **Usability:** A user-friendly interface is created that is easy to navigate and provides meaningful error messages when inputs are invalid.
- **Maintainability:** Code maintainability and readability for ease of future updates.
- **Performance:** Ensure fast processing and responsiveness to the user.
- **Portability:** Ensures easy transformation of an application to run smoothly on all browsers and devices.

Hardware Resources

- Processor : Intel i5

- RAM : 8GB
- Hard Disk : 100GB

Software Resources

- Operating System : Windows 11
- Programming Language : Python 3.11
- Front End : HTML, CSS

3.DESIGN

Software Architecture

The system architecture consists of a front-end built with HTML, CSS, and JavaScript for user interaction, and a back-end using Python to process images through a CNN model.

It enables users to upload railway track images and receive fault detection results in real-time.The architecture ensures smooth communication between the user interface and the processing logic, providing an efficient and user-friendly railway track fault detection system.

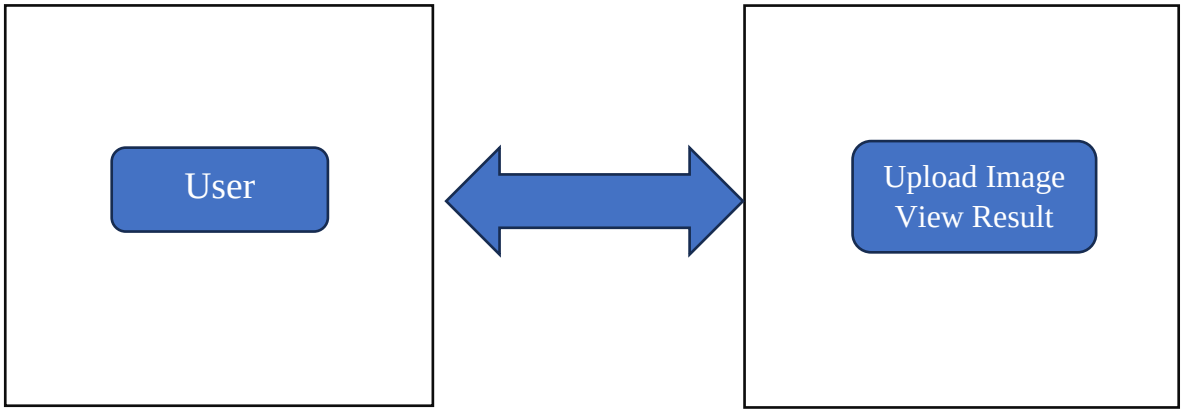


Fig 3.1 Software Architecture

Technical Architecture

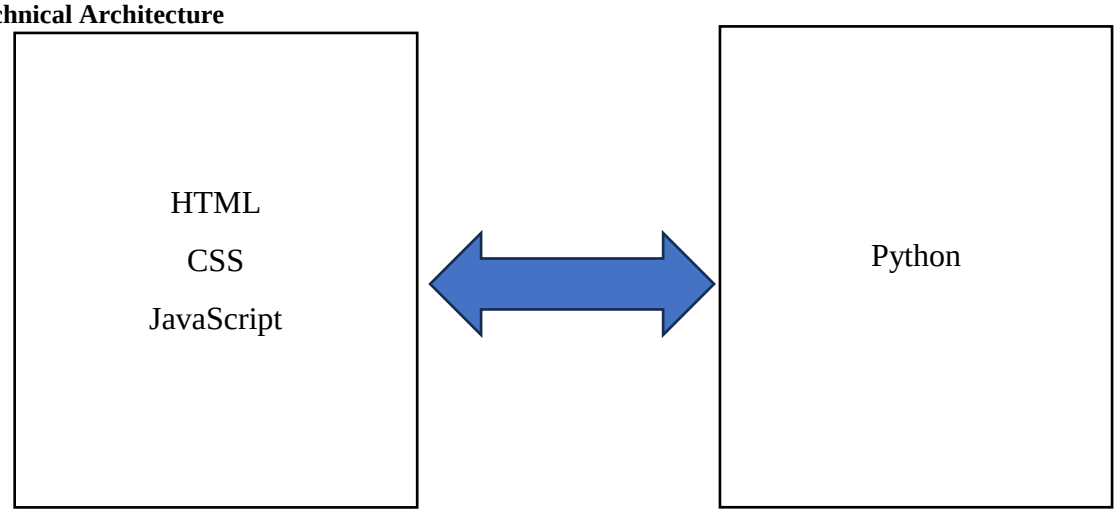


Fig 3.2 Technical Architecture

4.IMPLEMENTATION

Python

Python is an Object-Oriented, High-Level language, interpreted, dynamic and multipurpose programming language. Python is easy to learn yet powerful and

versatile scripting language which makes it attractive for application development. Python's syntax and dynamic typing with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas. Python supports multiple programming pattern, including object oriented programming, imperative and functional programming or procedural styles. Python is not intended to work on special area such as web programming. That is why it is known as multipurpose because it can be used with web, enterprise, 3d cad etc. We don't need to use data types to declare variable because it is dynamically typed so we can write a=10 to declare an integer value in a variable. Python makes the development and debugging fast because there is no compilation step included in python development and edit-test-debug cycle is very fast.

Features of Python

Easy To Use: Python is easy to very easy to use and high-level language. thus, it is programmer-friendly language.

Expressive Language: Python language is more expressive. the sense of expressive is the code is easily understandable.

Interpreted Language: Python is an interpreted language i.e. interpreter executes the code line by line at a time. this makes debugging easy and thus suitable for beginners.

Cross-Platform Language: Python Can Run Equally on Different Platforms Such as Windows, Linux, Unix , Macintosh Etc. Thus, Python Is a Portable Language.

Free And Open Source: Python language is freely available(www.python.org).the source-code is also available therefore it is open source.

Object-Oriented Language: Python supports object-oriented language. concept of classes and objects comes into existence.

Extensible: It implies that other languages such as c/c++ can be used to compile the code and thus it can be used further in your python code.

Python Applications

Python as a whole can be used in any sphere of development.

Console Based Application: Python can be used to develop console-based applications. for example: **python**.

Audio Or Video Based Applications: python proves handy in multimedia section. some of real applications are: Tim player, cplay etc.

3d Cad Applications:Fandango is a real application which provides full features of cad.

Web Applications:Python can also be used to develop web based application. some important developments are: pythonwikiengines, pocoo, pythonblogsoftware etc.

Enterprise Applications: Python can be used to create applications which can be used within an enterprise or an organization. some real time applications are: opener, tryton, picalo etc.

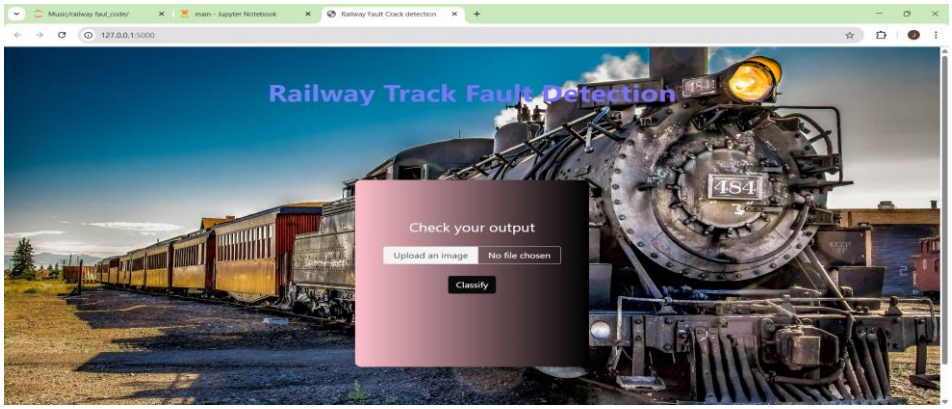
Applications For Images: Using python several applications can be developed for image. applications developed are: python, gogh, imgseek etc.

6. SCREENSHOTS

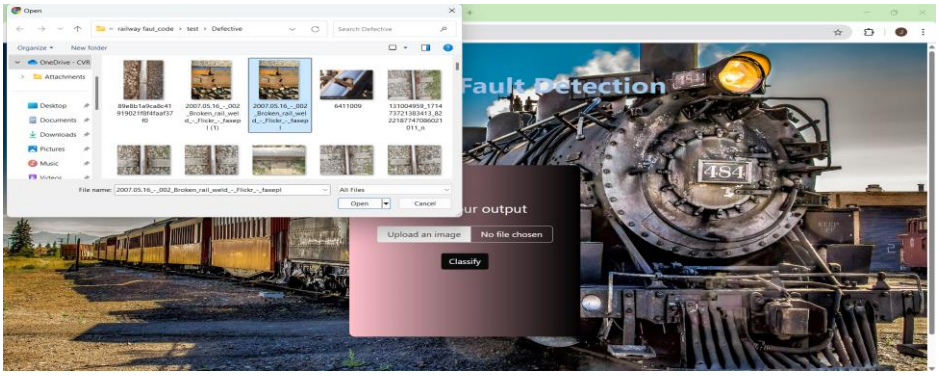
```
@app.route("/classify/<filename>")
def send_file(filename):
    return send_from_directory(UPLOAD_FOLDER, filename)


if __name__ == "__main__":

    app.run()
```

```
 * Serving Flask app "__main__" (lazy loading)
 * Environment: production
   WARNING: This is a development server. Do not use it in a production deployment.
   Use a production WSGI server instead.
 * Debug mode: off
 * Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

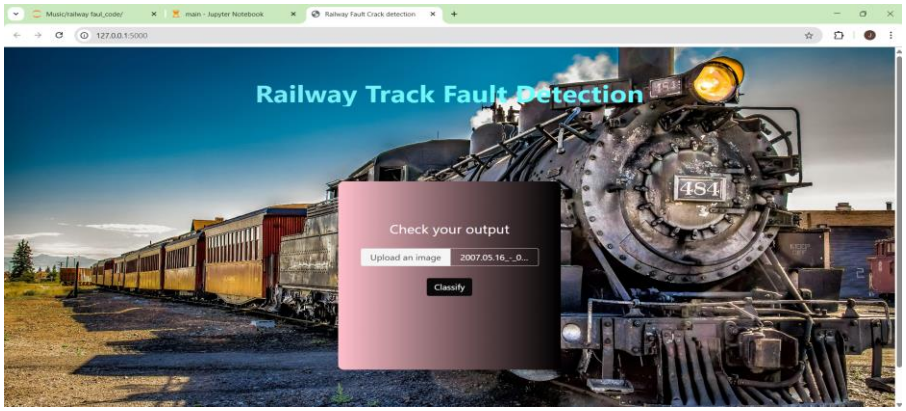
Screenshot 6.1 Link generated for webpage



Screenshot 6.2 Image showing home page of user interface.

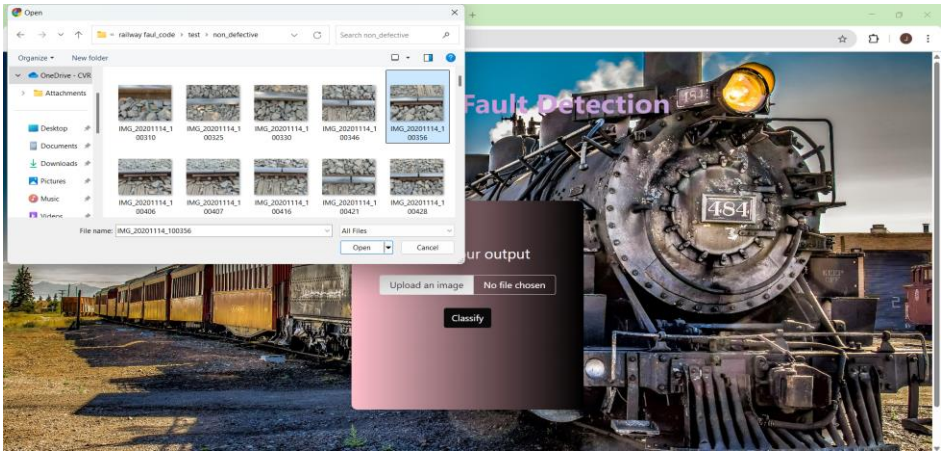


Screenshot 6.3 Image showing user to upload an image

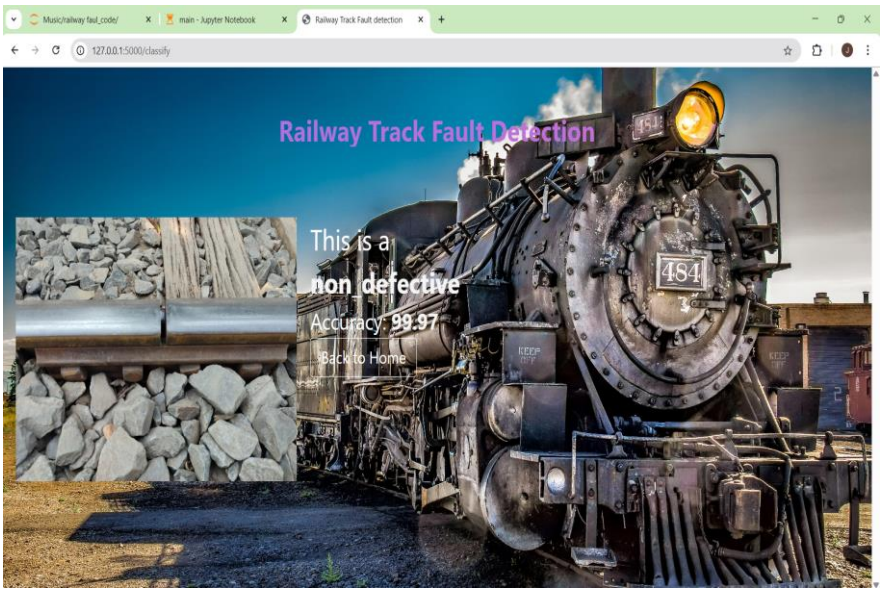


Screenshot 6.4 Image showing image uploaded by user

Screenshot 6.5 Result Page 1



Screenshot 6.6 Image showing user to upload another image



Screenshot 6.7 Result Page 2

7-CONCLUSION AND FUTURE SCOPE

A method to detect cracks in railway tracks has been presented using image processing technique. The proposed method helps to detect cracks with some manual working on the computer. Pictures of the tracks are taken with drone and given as input to the suggested system to detect cracks. This will help to detect cracks immediately and reduce the possibilities of accidents. The proposed method detects cracks with accuracy and hence the utmost efficiency of the system can be ensured. So with the help of image processing in python, it is able to find the cracks in the tracks easily.

Future Scope

The future scope of our project using CNN Dense Model includes to show faulty areas on map to help prioritize repairs and upgrade to use 3D cameras to find cracks or damages inside the track as well.

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