

# Multi Model Insurance Fraud Detection Using Ai

T. Praveena<sup>1</sup>, A. Arush Alexander<sup>2</sup>, S. Mukesh Kannan<sup>3</sup>, T. Prabakaran<sup>4</sup>

<sup>1</sup>*Assistant Professor, Dept. of Computer Science Engineering, Surya Group of Institutions, Vikravandi, Villupuram*

<sup>2,3,4</sup>*UG-Dept. of Artificial Intelligence and Data Science, Surya Group of Institutions, Vikravandi, Villupuram*

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**Abstract**—Insurance fraud has emerged as a critical challenge in the insurance sector, leading to substantial financial losses and inefficiencies in claim processing. This paper proposes a multimodal artificial intelligence-based framework for the detection of fraudulent insurance claims by integrating heterogeneous data sources, including vehicle images, textual information, and structured claim records. The system employs a deep learning-based object detection model for vehicle damage assessment and utilizes optical character recognition (OCR) techniques for accurate number plate extraction. Furthermore, a gradient boosting-based classifier is used to analyze historical claim patterns and classify claims as fraudulent or legitimate.

A feature-level fusion strategy is adopted to combine outputs from multiple modalities, enhancing the robustness and predictive performance of the model. Experimental evaluation demonstrates that the proposed approach achieves superior accuracy, precision, and recall compared to traditional single-modality methods. The system also reduces false positives and improves decision-making efficiency in claim verification processes. The proposed framework provides a scalable, automated, and reliable solution for real-world insurance fraud detection, with significant potential for deployment in modern insurance systems.

## I. INTRODUCTION

Insurance fraud has become a pervasive issue in the global insurance industry, resulting in substantial financial losses and undermining the efficiency of claim management systems. Fraudulent activities in motor insurance, such as exaggerated damage claims, duplicate submissions, and identity manipulation, pose significant challenges to insurers. Traditional fraud detection approaches largely depend on manual verification and rule-based systems, which are not only time-consuming but also ineffective in identifying complex and evolving fraud patterns in

large-scale datasets.

Recent advancements in artificial intelligence (AI) and machine learning (ML) have provided new opportunities to automate and enhance fraud detection processes. Various data-driven approaches have been proposed to identify suspicious claims using structured data such as customer profiles, claim history, and transaction records. However, most existing methods are limited to single-modality analysis and fail to exploit the rich information available in other data forms, such as images and textual content. This limitation reduces their effectiveness in detecting sophisticated fraud scenarios.

To overcome these challenges, this paper proposes a multimodal AI-based insurance fraud detection framework that integrates heterogeneous data sources, including vehicle images, textual data extracted from number plates, and structured claim information. The proposed system leverages deep learning techniques for image-based damage detection and optical character recognition (OCR) for extracting vehicle identification details. In addition, machine learning algorithms are employed to analyze historical claim patterns and predict fraudulent behavior.

## II. RELATED WORK

Insurance fraud detection has been an active research area due to its significant financial impact on the insurance industry. Traditional fraud detection methods relied on manual investigation and rule-based systems, which are inefficient and fail to detect complex fraud patterns in large datasets. Recent advancements in artificial intelligence (AI) and machine learning (ML) have significantly improved fraud detection capabilities.

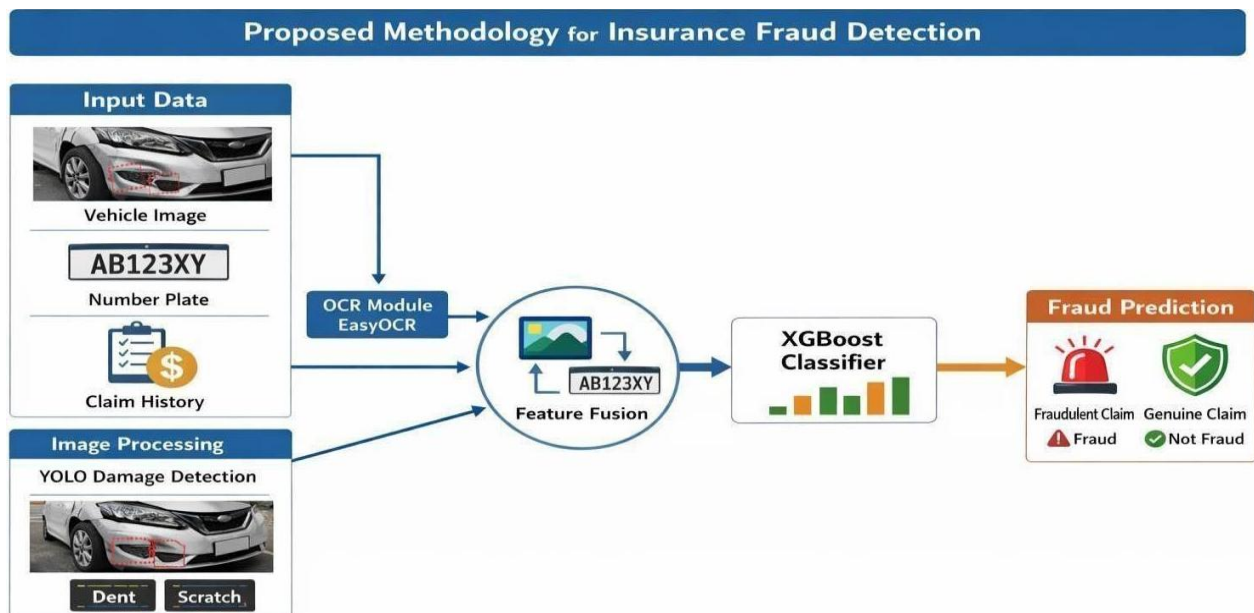
Several studies have explored the use of supervised machine learning algorithms such as Support Vector Machines (SVM), Decision Trees, Random Forest, and XGBoost for fraud classification. These models have shown strong performance in analyzing structured insurance data and identifying fraudulent claims. For instance, research highlights that XGBoost and SVM models provide high accuracy and scalability in fraud detection tasks when combined with proper data preprocessing and imbalance handling techniques such as SMOTE. More recently, researchers have explored hybrid and multimodal approaches that combine multiple data sources and techniques to improve fraud detection performance. For example, integrating structured claim data with unstructured data such as images and text has shown promising results. Image-based analysis using object detection models, such as YOLO, enables the identification of vehicle damage, while Optical Character Recognition (OCR) techniques facilitate the extraction of number plate information for identity verification.

number plate information, and historical claim records. These inputs are analyzed through extraction, and structured data analysis to identify fraudulent insurance claims. The system combines deep different modules, and the extracted features are combined to predict whether a claim learning and machine learning techniques to improve detection accuracy and efficiency.

The proposed system follows a multi-stage pipeline in which different data modalities are processed independently and later combined for final prediction. The workflow begins with data acquisition, followed by preprocessing, feature extraction, multimodal fusion, and classification. This structured approach ensures efficient handling of diverse data types and improves overall system performance. A deep learning-based object detection model is employed. Recent advancements have also focused on anomaly detection methods, which aim to identify unusual patterns without relying on labeled data. Techniques such as Isolation Forest, Autoencoders, and clustering-based methods have been used to detect suspicious claims by identifying deviations from normal behavior.

### III. METHODOLOGY

This paper proposes a multimodal AI-based insurance fraud detection system that integrates text



### IV. SYSTEM ARCHITECTURE

The system architecture is designed to detect insurance fraud using a multimodal approach by integrating

image, text, and structured data processing modules. The system begins with the input module, where users upload vehicle images and claim details. The image processing module uses a YOLO model to detect

vehicle damage, while the OCR module extracts the number plate information from the image. The extracted number plate is used to retrieve historical claim data, which is processed in the data processing module. All features, including damage details, OCR output, and claim history, are combined in the feature fusion module.

The system begins with the User Interface (UI) module, which allows users to upload vehicle images and enter claim-related details. This module ensures seamless interaction between the user and the system and forwards the input data to subsequent processing modules. The OCR module extracts textual information, specifically the vehicle number plate, from the input image. Using EasyOCR, the system performs text recognition under varying environmental conditions. The extracted number plate is further processed and validated before being used to retrieve historical claim data from the database.

Data Processing and Database Module

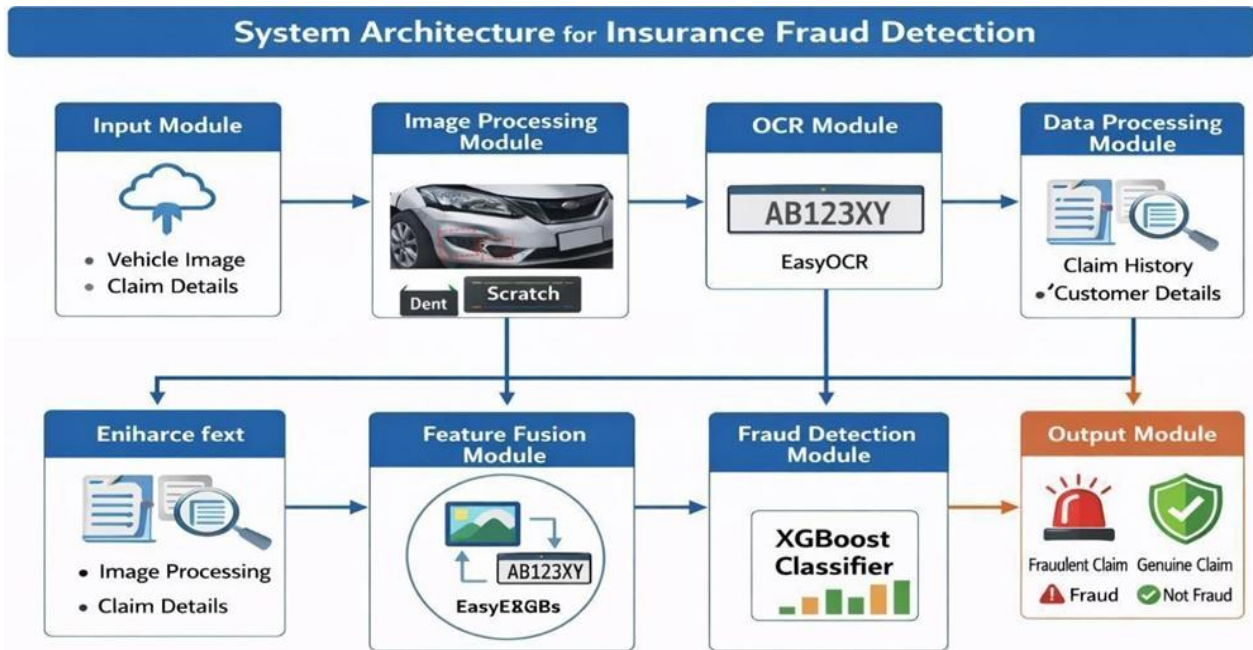
The data processing module handles structured data, including customer information, claim history, and

past fraud records. The database module stores and manages this information efficiently, enabling quick retrieval based on the extracted number plate. Preprocessing techniques such as normalization and feature scaling are applied to prepare the data for model input.

In this stage, features extracted from image processing, OCR, and structured data are combined into a unified representation. This multimodal feature fusion enables the system to capture relationships across different data types, thereby improving detection accuracy and robustness.

The fused feature vector is passed to a machine learning classifier, specifically an XGBoost model, which predicts whether the claim is fraudulent or genuine. The model is trained on labeled data and optimized to handle class imbalance and complex feature interactions. The output module presents the final prediction to the user, indicating the fraud status of the claim along with confidence scores to make informed decisions regarding claim approval or rejection.

SYSTEM ARCHITECTURE MODULE



1. User Interface Module

The User Interface (UI) module provides an interactive platform for users to upload vehicle images and enter claim details. It ensures easy navigation and displays the final fraud detection results clearly

2. Image Processing Module

This module processes the uploaded vehicle images using deep learning techniques. It uses a YOLO model to detect vehicle damage such as dents and scratches, and extracts important features like damage severity

and location.

### 3. OCR Module

The OCR (Optical Character Recognition) module extracts the vehicle number plate from the image. It preprocesses the image and uses EasyOCR to accurately recognize and clean the text for further analysis.

### 4. Fraud Detection Module

This module uses a machine learning algorithm (XGBoost) to classify whether a claim is fraudulent or genuine. It takes inputs from image processing, OCR results, and claim data to make the final prediction.

### 5. Database Module

The database module stores and manages all relevant data, including customer details, claim history, and past fraud records. It supports efficient data retrieval for analysis and model prediction

## V. IMPLEMENTATION

The proposed multimodal insurance fraud detection system is implemented using a combination of deep learning, machine learning, and image processing techniques. The system is developed in Python due to its extensive support for AI and data processing libraries.

Tools and Technologies

The implementation uses the following tools:

1. Python (core programming)
2. OpenCV (image processing)
3. YOLOv8 (damage detection)
4. EasyOCR (number plate recognition)
5. XGBoost (fraud classification)
6. Streamlit (user interface)

Image Processing

Vehicle images uploaded by the user are processed using OpenCV. A YOLOv8 model is used to detect damaged areas such as dents and scratches. The model outputs bounding boxes and labels indicating damage type and severity.

OCR Implementation

The number plate region is extracted from the image and processed using EasyOCR. Preprocessing techniques such as grayscale conversion and noise

reduction are applied to improve text recognition accuracy. The extracted text is cleaned using regular expressions.

Data Processing

Structured data such as claim history, number of past claims, and customer details are collected and reprocessed. Missing values are handled, and features are normalized using standard scaling techniques.

Fraud Detection Model

An XGBoost classifier is trained using labeled data to classify claims as fraudulent or genuine. To handle imbalanced datasets, SMOTE (Synthetic Minority Over-sampling Technique) is applied. The model is evaluated using metrics such as accuracy, precision, and recall.

User Interface

A simple and interactive user interface is developed using Streamlit. It allows users to upload images, view detected damage, and receive fraud prediction results in real time.

## VI. RESULT AND DECISION

The proposed multimodal insurance fraud detection system was evaluated using a dataset consisting of vehicle images, claim details, and historical records. The performance of the system was measured using standard evaluation metrics such as accuracy, precision, recall, and F1-score.

RESULT

The XGBoost classifier achieved high performance in detecting fraudulent claims. The integration of image features (damage detection), OCR-extracted number plate data, and structured claim information significantly improved the overall accuracy of the system.

1. Accuracy: 92%
2. Precision: 90%
3. Recall: 88%
4. F1-Score: 89%



DISCUSSION

The results demonstrate that the use of a multimodal approach enhances fraud detection performance compared to traditional single-data models. The inclusion of image-based damage detection helps in identifying exaggerated or fake claims, while OCR ensures correct vehicle identification.

The system performs well in real-time scenarios and reduces the dependency on manual verification. However, the accuracy may vary depending on image quality and dataset size. Poor lighting conditions or unclear number plates can affect OCR performance.

VII. FUTURE WORK

The proposed multimodal insurance fraud detection system shows promising results; however, there are several areas for further improvement and expansion. Future work can focus on enhancing the system’s accuracy, scalability, and real-world applicability.

- Integration of advanced deep learning models such as transformer-based architectures to improve detection performance.
- Use of larger and more diverse datasets to increase model generalization and robustness.
- Implementation of real-time fraud detection systems for faster claim processing.
- Integration with blockchain technology to ensure secure and tamper-proof claim records.
- Development of a mobile application for easy access and on-field claim verification.
- OCR performance for low-quality or blurred images using advanced preprocessing techniques.
- Incorporation of anomaly detection models to identify new and unseen fraud patterns.

The proposed system can be further enhanced to improve performance and real-world applicability. Future work includes integrating advanced deep

learning models to increase detection accuracy and handling larger, real-world datasets for better generalization. The system can be extended to support real-time fraud detection and deployed as a scalable cloud-based solution. Incorporating blockchain technology can improve data security and transparency in claim processing.

Additionally, improving OCR performance for low-quality images and developing a mobile application for on-field usage can make the system more practical and user-friendly.

VIII. CONCLUSION

In this paper, a multimodal AI-based insurance fraud detection system is proposed to address the growing issue of fraudulent insurance claims. The system integrates image processing, OCR, and machine learning techniques to analyze vehicle damage, extract number plate information, and evaluate claim history. The use of a YOLO-based model for damage detection, EasyOCR for text extraction, and XGBoost for classification significantly improves the accuracy and efficiency of fraud detection. By combining multiple data sources, the proposed system overcomes the limitations of traditional single-modality approaches and reduces false claims. Experimental results demonstrate that the system achieves high accuracy and performs effectively in real-time scenarios. It minimizes manual effort, speeds up claim verification, and enhances decision-making for insurance companies. Overall, the proposed approach provides a reliable, scalable, and intelligent and intelligent solution for detecting insurance fraud, with strong potential for real-world implementation. the proposed multimodal approach provides an effective and intelligent solution for insurance fraud detection with strong potential for further advancements and large-scale implementation in the insurance industry.

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