Advanced AI-Driven Framework for Automated Insurance Claim Processing

**Abstract** This paper presents a comprehensive AI-based framework for automating insurance claim processing. The approach integrates multiple models, including NLP, OCR, object detection, and transformer-based image-to-text techniques, to streamline the process of filling insurance claim forms. The system collects user-provided information, processes image data, and uses advanced AI models to extract, validate, and summarize information into a detailed two-page report, ensuring efficiency and accuracy.

**Introduction** Insurance claim processing is a labor-intensive and time-consuming task that requires significant manual effort to collect and verify details. Our proposed AI-powered framework automates this workflow by combining multiple AI models for natural language processing (NLP), optical character recognition (OCR), and computer vision. This system seamlessly integrates user-provided data with extracted insights from documents and images, offering a robust, end-to-end solution for insurance claim automation.

**Methodology**

**Step 1: User Information Collection** The first step collects critical user-provided details required for claim processing. These include:

* Email address
* Address of the incident
* Date of the incident (formatted as dd/mm/yyyy)
* Policy number
* Description of the incident
* List of damages

The system employs an NLP-based regex parser and a Retrieval-Augmented Generation (RAG) model to extract key details from unstructured text inputs. For example, names, locations, and dates are extracted and validated, while free-text descriptions are summarized into a concise JSON format using a large language model (LLM). This ensures that the data conforms to the structure required for downstream processing.

**Step 2: Document Processing with OCR** The second step involves extracting details from user-uploaded identification documents using an OCR model. Key fields extracted include:

* Name (given and last names)
* Date of birth (DOB) in dd/mm/yyyy format
* Gender
* Address (city and country)

Fine-tuning the OCR model allowed for higher accuracy when parsing structured and semi-structured documents such as driver’s licenses and passports. Post-extraction, the data undergoes a cleaning and validation step to ensure consistency with user-provided information. Any discrepancies are flagged for review.

**Step 3: Damage Assessment Using Vision Models** The third step addresses image-based inputs, where users upload multiple damage images. Our framework uses a combination of object detection and transformer-based image-to-text models to analyze and describe the content of these images. For example:

* Object detection identifies damaged components (e.g., broken windows, dented car doors).
* Image-to-text translation summarizes these observations into coherent descriptions (e.g., “The front-left bumper is heavily scratched,” or “The windshield is shattered”).

This step employs pre-trained vision models fine-tuned on insurance-specific datasets to improve the relevance and accuracy of descriptions.

**Step 4: Summary and Report Generation** The final step combines all the extracted and validated data into a comprehensive two-page insurance claim report. A RAG model integrates textual and visual information, while an LLM generates a human-readable summary. Key components of the report include:

* User information (e.g., name, email, policy number, and address)
* Description of the incident
* Detailed list of damages (text and visual summaries)
* Extracted ID details for verification

The report’s structured format adheres to insurance industry standards, enabling seamless integration with existing workflows.

**Technical Contributions**

1. **Multi-modal Integration**: Combines NLP, OCR, and computer vision models to process diverse data inputs.
2. **Fine-tuning for Domain Specificity**: Enhances model performance through fine-tuning on insurance-specific datasets.
3. **End-to-End Automation**: Reduces manual effort by automating data extraction, validation, and report generation.
4. **RAG and LLM Capabilities**: Leverages retrieval-augmented generation and large language models to produce coherent, structured summaries and JSON outputs.

**Conclusion** Our proposed framework demonstrates the potential of AI-driven solutions to transform insurance claim processing. By leveraging cutting-edge NLP, OCR, and vision models, the system achieves high accuracy and efficiency, streamlining a traditionally complex workflow. Future work includes further optimization of fine-tuned models and integration with real-time fraud detection mechanisms.

**Keywords**: Insurance claim automation, OCR, NLP, computer vision, RAG model, LLM, object detection, image-to-text.

