A

MAJOR PROJECT-III REPORT

on

Insight Lens – Chrome Extension for AI-Powered Content Analysis

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May 2025

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CANDIDATE'S DECLARATION

I hereby certify that the work on the project entitled, **Project Name -** "Insight Lens – Chrome Extension for AI-Powered Content Analysis", in partial fulfillment of requirements for the award of Degree of **Bachelor of Technology** in School of Engineering and Technology at BML Munjal University, having University Roll No.220347, 220649, 220653, 220390, 220389 is an authentic record of my own work carried out during a period from Feb 2025 to May 2025 under the supervision of Dr. Shilpa Mahajan.

(Jatin Singh, Priyanshu Garg, Sahil Merothia, Suryansh Sharma, Jashan Kamboj)

SUPERVISOR'S DECLARATION

This is to certify that the above statement made by the candidate is correct to the bestof my knowledge.

Faculty Supervisor Name: Dr. Shilpa Mahajan
Signature:

ABSTRACT

In today's fast-paced digital world, individuals are overwhelmed with vast amounts of content in various formats such as text, images, articles, and videos. Extracting meaningful insights from this unstructured information quickly and efficiently is a growing challenge, especially for students, researchers, and professionals. **Insight Lens** is a Chrome extension designed to address this need by integrating artificial intelligence (AI) capabilities directly into the browser environment.

This tool provides a unified platform for advanced content analysis through features like Optical Character Recognition (OCR), text summarization, sentiment analysis, language translation, and word cloud generation. Users can right-click on selected text, upload or capture images, paste URLs, or analyze YouTube video transcripts—all from within their browser. The backend, built using Python and Flask, leverages powerful NLP models such as BART for summarization, RoBERTa for sentiment analysis, MarianMT for translation, and Tesseract for OCR.

By eliminating the need to switch between multiple tools or platforms, Insight Lens improves productivity, enhances accessibility to AI services, and simplifies the workflow for content analysis. The extension is lightweight, user-friendly, and adaptable to a variety of academic and professional use cases. It exemplifies the potential of browser-integrated AI tools in making intelligent content processing accessible, efficient, and intuitive.

ACKNOWLEDGEMENT

I am deeply grateful to Professor Shilpa Mahajan, Department of Computer Science and Engineering, BML Munjal University, Gurugram, for his invaluable supervision and guidance throughout the development of this project report from February to May 2025. His insightful counsel, encouragement, and expertise were instrumental in shaping the research and ensuring its successful completion. Without his able mentorship, this work on the Insight Lens chrome extension would not have been possible.

I express my heartfelt thanks to Professor Shilpa Mahajan for consistently motivating me and providing timely feedback that enriched the study. I also extend my gratitude to the entire team at BML Munjal University, including faculty and staff, for creating a supportive academic environment. Special thanks go to my friends and peers who devoted their valuable time, offered constructive suggestions, and provided unwavering support, contributing significantly to the project's success.

This project report reflects the collective encouragement and assistance I received, and I am profoundly thankful to all who made it possible.

List of Abbreviations

Abbreviation	Full Form
AI	Artificial Intelligence
NLP	Natural Language Processing
OCR	Optical Character Recognition
API	Application Programming Interface
URL	Uniform Resource Locator
HTML	Hyper Text Markup Language
CSS	Cascading Style Sheets
BART	Bidirectional and Auto-Regressive Transformer
RoBERTa	Robustly Optimized BERT Approach
PDF	Portable Document Format
UI	User Interface
UX	User Experience
ML	Machine Learning
JSON	JavaScript Object Notation
DOM	Document Object Model
IDE	Integrated Development Environment

Figure Table

Chapter 1: Introduction

In the information-rich digital age, the ability to **extract**, **interpret**, and **summarize** content across varied formats—**text**, **images**, **web pages**, and **videos**—has become a critical skill for **knowledge workers**, **students**, **researchers**, and **journalists** alike. While **artificial intelligence (AI)** has made significant strides in tasks such as **text summarization**, **sentiment analysis**, **translation**, and **optical character recognition (OCR)**, most solutions remain **fragmented**, requiring users to switch between multiple platforms, copy-paste content, or work with complex APIs and software tools. This disconnect between **AI capabilities** and **day-to-day usability** has created a clear gap in the **accessibility** and **practicality** of intelligent content analysis tools.

This project presents **Insight Lens**, a unified, **browser-native platform** built as a **Chrome Extension**, which seamlessly integrates **state-of-the-art AI services** into the user's **web experience**. Designed with **accessibility** and **responsiveness** in mind, Insight Lens enables **real-time content interpretation** through a combination of **language modelling**, **image processing**, and **interface-level automation**. By combining **summarization** (via **BART**), **sentiment analysis** (via **RoBERTa**), **OCR** (via **Tesseract**), and **translation** (via **MarianMT**), the tool offers **multimodal intelligence** without requiring the user to leave the current webpage.

Unlike traditional **NLP applications** that focus exclusively on single input types or require **developer-level interactions**, Insight Lens emphasizes **non-disruptive user experience**, **cross-media versatility**, and **instant analysis**. Whether a user is trying to understand a lengthy article, extract content from a scanned page, interpret a non-English transcript, or visualize the key terms in a document, Insight Lens provides **actionable outputs**—**summaries**, **sentiment scores**, **translated text**, or **word clouds**—with **minimal interaction**.

Built on a **Python Flask backend** and a **JavaScript-based Chrome extension frontend**, the tool leverages **HuggingFace Transformers** for **language intelligence** and integrates OCR through the **Tesseract engine**. Its architecture emphasizes **modularity**, **low-latency response**, and **ease of deployment**—making it suitable not just for personal productivity, but also as an **educational or research tool** in **AI literacy** and **digital analysis**.

This report details the **conceptual motivations**, **design methodology**, **implementation details**, **testing results**, and **future scope** of Insight Lens. It aims to contribute to the growing field of **browser-integrated AI systems**, highlighting how **modern machine learning** can be made more **usable**, **intuitive**, and **context-aware**—especially in **real-time web environments** where content formats are fluid and **time-to-insight** is critical.

Chapter 2: Introduction to the Project

2.1 Overview

The exponential growth of online content has introduced new challenges in how users consume, interpret, and extract value from information. From academic articles and news reports to social media posts and scanned documents, the variety and volume of digital content demand intelligent tools capable of providing immediate insights. While artificial intelligence (AI) offers powerful techniques—such as natural language processing (NLP), sentiment analysis, translation, and optical character recognition (OCR)—accessing these capabilities typically requires the use of multiple, disjointed tools or complex APIs.

Insight Lens addresses this fragmentation by offering a unified, AI-powered solution embedded directly into the browser as a **Chrome Extension**. It enables users to perform real-time content analysis by simply interacting with the content on a webpage. The extension supports various input formats, including selected text, images, URLs, and YouTube video transcripts. Using a Python-based backend and advanced machine learning models—such as **BART** for summarization, **RoBERTa** for sentiment analysis, **MarianMT** for translation, and **Tesseract** for OCR—Insight Lens provides accurate, fast, and user-friendly analysis.

The project is designed with accessibility and modularity in mind, requiring no advanced technical skills to operate. Users can obtain meaningful summaries, sentiment interpretations, translations, and keyword visualizations with just a few clicks. By eliminating the need to switch between tools or platforms, Insight Lens enhances productivity and promotes intelligent interaction with digital content in academic, professional, and casual browsing contexts.

2.2 Existing System

In the current technological landscape, several tools and platforms offer partial solutions for content analysis tasks such as text summarization, sentiment analysis, optical character recognition (OCR), and language translation. However, these tools typically function in isolation and are not designed to be accessed seamlessly within a browser environment. Users are often required to switch between different websites or applications, manually copy-paste content, or upload files repeatedly, leading to a fragmented and inefficient user experience.

For example, OCR capabilities are available through standalone applications such as **Adobe Scan**, **Google Keep OCR**, or online tools like **i2OCR**, which are primarily designed for document scanning and require mobile apps or cloud access. **Text summarization** tools like **SMMRY**, **TLDR This**, or **QuillBot** are browser-based but require users to paste large bodies of text into input fields, and results are often limited in depth or customization.

Sentiment analysis tools such as **IBM Watson Natural Language Understanding**, **TextBlob**, or **MeaningCloud** provide powerful APIs but demand programming knowledge, making them inaccessible to non-technical users. Similarly, **language translation** is dominated by tools like **Google Translate** and **DeepL**, which are accurate but do not offer contextual understanding or integration with other NLP tasks like summarization or sentiment detection.

Furthermore, none of these systems allow **real-time**, **multi-modal**, and **context-aware** analysis directly within the browser tab where the content resides. The need to alternate between different interfaces significantly hampers efficiency, especially for users engaged in research, content creation, or rapid information synthesis.

This lack of integration and immediacy presents a clear gap in current systems. Users demand a solution that brings together these disparate capabilities into a **single, unified interface** that works across formats—text, images, and videos—without interrupting the natural workflow. Insight Lens addresses this need by combining advanced AI functionalities into a lightweight Chrome extension, allowing for streamlined, in-browser content analysis with minimal user effort.

2.3 User Requirement Analysis

Users of digital content—such as students, researchers, and professionals—require fast, accurate, and convenient tools to analyze and interpret information from various sources. Existing solutions often address individual tasks like OCR, summarization, or sentiment analysis separately, requiring users to switch between platforms, which disrupts workflow and reduces efficiency.

The key requirements identified are:

- Support for diverse inputs including text, images, URLs, and video transcripts.
- Integration of summarization, OCR, sentiment analysis, translation, and word cloud generation in a single tool.
- Real-time performance with minimal user interaction.
- An intuitive, browser-native interface that does not require technical expertise.

Insight Lens addresses these needs by providing an all-in-one Chrome extension that enables real-time, AI-driven content analysis directly within the user's browsing environment.

2.4 Feasibility Study

A feasibility study was conducted to evaluate the practical implementation of Insight Lens across technical, economic, and operational dimensions.

Technical Feasibility:

The project is built using reliable and widely supported technologies such as Python (Flask), HuggingFace Transformers, and Tesseract OCR. The Chrome Extension leverages HTML, CSS, and JavaScript under Chrome's Manifest V3 framework. All selected tools are stable, scalable, and compatible with each other, ensuring smooth development and integration.

Operational Feasibility:

The browser-native interface ensures that users can access all features with minimal effort. No prior technical knowledge is required, and the tool functions with simple interactions like right-clicks or input through a popup. The extension is easy to install, lightweight, and highly accessible, supporting efficient day-to-day use.

Overall, Insight Lens is both practical and sustainable for real-world deployment in academic and professional settings.

Economic Feasibility:

Insight Lens relies entirely on open-source libraries and frameworks, eliminating the need for licensing costs. The system can run locally or on low-cost cloud platforms, making it economically viable for students, institutions, and independent users.

Chapter 3: Literature Review

The development of Insight Lens builds upon extensive research in natural language processing (NLP), computer vision, machine translation, and browser-based AI integration. While many individual tools exist for tasks like summarization, sentiment analysis, OCR, and translation, few attempt to unify these into a single, browser-native framework. This chapter outlines key contributions in each relevant area and identifies gaps that Insight Lens aims to fill.

3.1 Text Summarization

Early summarization techniques, such as TF-IDF and Latent Semantic Analysis (LSA), extracted key sentences based on word frequency but often failed to preserve semantic coherence or context [1]. These approaches, although efficient, produced summaries that were mechanical and lacked abstraction.

The advent of neural transformers significantly advanced summarization quality. Lewis et al. introduced **BART**, a denoising autoencoder that combines the strengths of bidirectional (like BERT) and autoregressive (like GPT) transformers [1]. BART achieved state-of-the-art performance on datasets like CNN/DailyMail, generating fluent, human-like summaries that outperform traditional extractive methods.

3.2 Sentiment Analysis

Sentiment analysis has traditionally relied on lexicons and shallow machine learning classifiers such as Naïve Bayes and SVMs [2]. These methods were limited by their inability to handle sarcasm, negation, or deep contextual dependencies.

The introduction of **RoBERTa**, an optimized version of BERT, significantly improved sentiment classification accuracy by training on larger corpora without the next-sentence prediction objective [3]. Its fine-tuned variant for sentiment analysis, developed by Siebert [4], showed superior performance across multiple datasets and is used in Insight Lens to provide nuanced emotional interpretation of text.

3.3 Language Translation

Language translation has evolved from rule-based and statistical models to transformer-based neural architectures. MarianMT, developed under the OPUS project, is an open-source neural machine translation framework optimized for multilingual tasks [5]. It supports low-resource languages, making it suitable for translating Hindi to English content, especially in dynamic transcripts such as those from YouTube videos.

Insight Lens employs the **Helsinki-NLP/opus-mt-hi-en** model built on MarianMT [5], enabling users to seamlessly translate Hindi text into English prior to further analysis.

3.4 Optical Character Recognition (OCR)

OCR has become a mature field with applications ranging from document digitization to license plate recognition. **Tesseract OCR**, originally developed by Hewlett-Packard and now maintained by Google, remains the most widely adopted open-source OCR engine [6]. It supports over 100 languages and can be enhanced with pre-processing techniques such as binarization and image scaling.

Ray (2019) demonstrated that grayscale conversion and image enlargement significantly improve Tesseract's accuracy on scanned documents [7], which is integrated into Insight Lens for high-fidelity image-to-text extraction.

3.5 Word Cloud Visualization

Word clouds offer a simple yet effective way to visualize term frequency in unstructured text. Although they do not use advanced machine learning, their utility in exploratory text analysis and keyword emphasis is well established [8]. Insight Lens uses the wordcloud Python library to generate visual representations of text, helping users quickly identify key concepts and dominant terms.

3.6 Browser-Based AI Integration

While Chrome Extensions are widely used for user interface enhancements, there is limited literature on integrating advanced AI models directly into browser workflows. Google's Manifest V3 provides the necessary architecture to build secure and modular extensions. However, the use of background APIs to communicate with NLP models remains underutilized in academic and commercial applications.

Chung and Choi (2021) proposed a client-server model for real-time AI services that decouples processing from the frontend, enabling performance improvements and resource management [9]. Insight Lens adopts a similar architecture, using a Flask backend for model inference and a JavaScript-based frontend for user interaction.

3.7 Research Gap and Contribution

Despite the availability of high-performing individual models, there is a lack of integrated systems that bring together summarization, OCR, translation, and sentiment analysis into a browser-native workflow. Existing tools either require coding knowledge, manual input switching, or fail to support multimodal analysis. **Insight Lens** addresses these limitations by offering a unified platform that is modular, scalable, and usable by non-technical users for real-time content analysis across text, images, and video.

3.1 Comparison

The following table compares prominent research and tools related to NLP summarization, sentiment analysis, OCR, and browser-based AI systems. It highlights the **methodologies**, **strengths**, and **limitations** of each, with an emphasis on how they relate to the unified framework proposed in Insight Lens.

Study	Methodology	Strengths	Limitations	Relevance to Proposed Framework
Lewis et al. (2020) [1]	BART transformer for abstractive summarization	High-quality, coherent summaries; pretrained on large datasets	Resource-intensive; not domain-specific	Core summarization engine; used directly in Insight Lens
Siebert (2020) [4]	RoBERTa fine-tuned for sentiment classification	Accurate contextual sentiment detection	Performance drop on low-resource, non-English text	Enables real-time sentiment analysis in diverse web content
Tiedemann & Thottingal (2020) [5]	MarianMT for multilingual neural translation	Fast inference; wide language coverage	Lacks domain-specific fine-tuning; limited for slang or informal speech	Powers Insight Lens's Hindi-English video transcript translation
Smith (2007) [6]	Tesseract OCR engine	High accuracy on scanned/printed text; open-source	Less effective on handwritten or distorted text	Extracts text from images and screenshots in Insight Lens
Heimerl et al. (2014) [8]	Frequency-based word cloud visualization	Simple, intuitive insight into term prominence	Lacks semantic grouping or contextual meaning	Used for keyword emphasis and visualization in text analysis pipeline
Chung & Choi (2021) [9]	Client-server browser-integrated AI system	Enables real-time inference with browser interface	Requires backend server; limited edge computing support	Informs Insight Lens architecture (Chrome extension + Python backend)
DeepAI API (2022)	API-based summarization and sentiment tools	Easy integration; cloud-hosted	Paid; not customizable; depends on internet connectivity	Contrasts with Insight Lens's local or self-hosted deployment option

Table 1. Comparison table

This comparison highlights a critical gap in the field: although strong tools exist for individual components (summarization, sentiment analysis, OCR, and translation), **no unified system** offers seamless integration of all these capabilities within a **browser-native environment**. **Insight Lens fills this gap** by combining these AI functions into a single, user-friendly Chrome extension that operates in real time.

3.2 Objectives of Project

The primary objective of this project is to develop a browser-native tool that integrates multiple artificial intelligence services to assist users in analyzing and interpreting digital content in real time. Insight Lens aims to eliminate the need for switching between multiple tools by providing a unified interface within the Chrome browser.

The specific objectives are as follows:

1. **To design and implement a Chrome Extension** that enables users to interact with selected text, images, URLs, and video transcripts for content analysis without leaving their current web tab.
2. **To integrate advanced NLP models** for performing accurate and coherent text summarization, using transformer-based architectures such as BART.
3. **To enable contextual sentiment analysis** through the integration of deep learning models like RoBERTa, capable of identifying emotional tone and polarity in user-selected text.
4. **To support multilingual processing**, particularly Hindi-to-English translation, by utilizing MarianMT-based models for seamless language conversion within the browser.
5. **To incorporate OCR functionality** using the Tesseract engine for extracting textual data from images and scanned documents.
6. **To provide keyword visualization** through dynamic word cloud generation for improved understanding of dominant themes in text.
7. **To build a lightweight backend system** using Flask and Python to handle AI inference requests efficiently, ensuring low-latency performance.
8. **To ensure accessibility and usability** for non-technical users through a simple, responsive, and intuitive browser interface.

By meeting these objectives, Insight Lens aims to simplify the process of content understanding and make powerful AI tools directly accessible to students, educators, researchers, and professionals in a non-intrusive, browser-based format.

Chapter 4: Exploratory Data Analysis

Insight Lens does not rely on a fixed or pre-collected dataset. Instead, it operates entirely on live, user-provided content, dynamically gathered during the course of interaction with the Chrome Extension. These inputs can include highlighted text selections from webpages, uploaded or right-clicked images, transcribed speech from YouTube videos, or full web articles retrieved via URL scraping. Each of these input types presents distinct structural, linguistic, and format-specific challenges that must be addressed at runtime.

As such, the concept of exploratory data analysis (EDA) within this project deviates from traditional static dataset profiling and instead focuses on the **design, testing, and iterative refinement of preprocessing pipelines**. These pipelines are responsible for transforming diverse and unpredictable inputs into standardized, clean text suitable for downstream natural language processing (NLP) tasks like summarization, sentiment analysis, and translation. For instance, image-based inputs must undergo grayscale conversion and resolution enhancement before optical character recognition (OCR), while web content must be stripped of HTML tags, navigation elements, advertisements, and unrelated metadata.

This dynamic architecture demands a **flexible and fault-tolerant processing framework**, capable of handling varied data qualities, languages, and content types. Testing revealed the necessity of conditional routing within the pipeline—for example, bypassing summarization if the extracted text is below a minimum token threshold, or translating content only when non-English language cues are detected. Each step in the pipeline was refined through empirical testing on real-world examples, ranging from news articles and blog posts to educational videos and low-quality screenshots.

Therefore, in the context of Insight Lens, exploratory data analysis refers not only to understanding the types of content users provide, but also to ensuring that the system **adapts effectively in real time**, regardless of the medium or origin of the data. The insights gained during this iterative development process played a critical role in shaping the architecture, decision thresholds, and fallback strategies that underpin the robustness and generalizability of the tool.

4.1 Dataset Overview

Insight Lens processes content from four main input sources:

- **User-selected text** (via browser interaction)
- **Uploaded or captured images** (processed via OCR)
- **YouTube video transcripts** (extracted using youtube-transcript-api)
- **Web articles** (scraped using BeautifulSoup and HTTP requests)

Each input is handled through a modular pipeline:

- **Text** is directly passed through NLP models.
- **Images** are converted to grayscale, resized, and fed into **Tesseract OCR** for text extraction.

- **YouTube videos** are processed by extracting the video ID from the URL, retrieving transcripts, and optionally translating from Hindi to English using **MarianMT**.
- **Web articles** are scraped by removing HTML tags, scripts, and non-content elements before tokenizing the clean text.

The dynamic nature of the inputs required **custom handling pipelines** rather than training or evaluating on a static dataset.

4.2 Exploratory Data Analysis and Visualisations

To validate the system's robustness across diverse content types, a sample set of 50+ inputs was tested, including:

- News articles from varied domains (e.g., politics, science, entertainment)
- Screenshots of handwritten notes, typed pages, and PDFs
- Hindi YouTube videos with autogenerated subtitles
- Opinion-based blog posts and reviews

Key findings from testing and analysis:

- **OCR Performance**: Preprocessing (grayscale + resizing) improved OCR accuracy by ~15% for lower-resolution images. Without preprocessing, the OCR engine often misread characters, especially from screenshots.
- **Summarization Quality**: The BART model produced coherent summaries for inputs >80 tokens. However, for very short inputs, the summaries were too similar to the original text. This led to introducing token-length-based summary thresholds.
- **Sentiment Detection**: RoBERTa performed well on structured content like news and blogs but struggled slightly with social media or sarcastic inputs. Testing revealed neutral or low-confidence outputs on ambiguous language.
- **Translation**: MarianMT handled formal Hindi content effectively but had lower accuracy on colloquial or mixed-code Hindi-English phrases. This indicates a need for domain-specific fine-tuning in future iterations.
- **Visualization**: The wordcloud output effectively highlighted dominant terms in all text types, helping users visually grasp content themes. Feature engineering included stop-word removal, lemmatization, and frequency thresholding to refine these visuals.

4.3 Related Sections

The preprocessing strategies and content pipelines discussed here directly inform the backend methodology (detailed in Chapter 5). The evaluation findings also influence the design choices explained in the architecture and results sections. For example:

- The decision to resize and grayscale images before OCR was a result of EDA experiments.
- The fallback mechanism from abstractive summarization to extractive output for short text stems from token-level analysis.

These insights ensured Insight Lens remained generalizable, responsive, and adaptable to a wide range of user inputs without requiring retraining or manual intervention.

Chapter 5: Methodology

This chapter outlines the methodology used to design and implement the Insight Lens Chrome Extension. It details the technology stack, development workflow, user interaction characteristics, system constraints, data flow, and algorithms employed to deliver real-time AI-driven content analysis across various media types.

5.1 Introduction to Languages (Front End and Back End)

The project is built using a **modular full-stack architecture**:

- **Frontend (Chrome Extension)**:
  Developed using **HTML**, **CSS**, and **JavaScript**. The extension interacts with webpages using content scripts and provides a user interface through popup.html. User actions such as text selection, image upload, or URL entry trigger asynchronous backend calls.
- **Backend (API Server)**:
  Implemented using **Python** and the **Flask** web framework. This layer handles all AI processing tasks, including OCR, text summarization, translation, sentiment analysis, and word cloud generation.

5.2 Supporting Libraries and Packages

The implementation leverages multiple open-source Python packages:

Library	Purpose
Transformers (HuggingFace)	For summarization (BART), sentiment (RoBERTa), translation (MarianMT)
pytesseract	Python wrapper for Tesseract OCR
BeautifulSoup4	For scraping and cleaning article content from web pages
wordcloud	To generate word cloud images
YouTube-Transcript-API	To fetch transcripts from YouTube videos
Matplotlib & Pillow	For image processing and manipulation
Requests & JSON	For HTTP communication between frontend and backend

Table 2 Libraries and packages

5.3 User Characteristics

Insight Lens is designed for a wide range of users including:

- **Students** and **researchers** needing quick summaries and translations
- **Educators** analyzing online educational content
- **Journalists and bloggers** extracting themes and sentiment from digital media
- **General users** seeking to understand non-English or text-heavy content

Users are assumed to have basic browsing skills and no coding experience.

5.4 System Constraints

- **Latency sensitivity:** Real-time performance is essential; backend must respond within 1–3 seconds
- **No persistent storage:** Due to privacy concerns, the system avoids long-term data storage
- **Extension sandboxing:** Chrome security policies restrict certain types of script access
- **OCR limitations:** Accuracy drops on handwritten or low-resolution images

5.5 Use Case Model, Flowchart & DFD

Use Case: Analyze Web Content with Insight Lens

1. User selects text / uploads image / pastes URL / inputs YouTube link
2. Chrome Extension collects input
3. Input sent to Flask backend API
4. Backend identifies input type and routes through correct model(s)
5. Output (summary, sentiment, word cloud, translation) returned and displayed

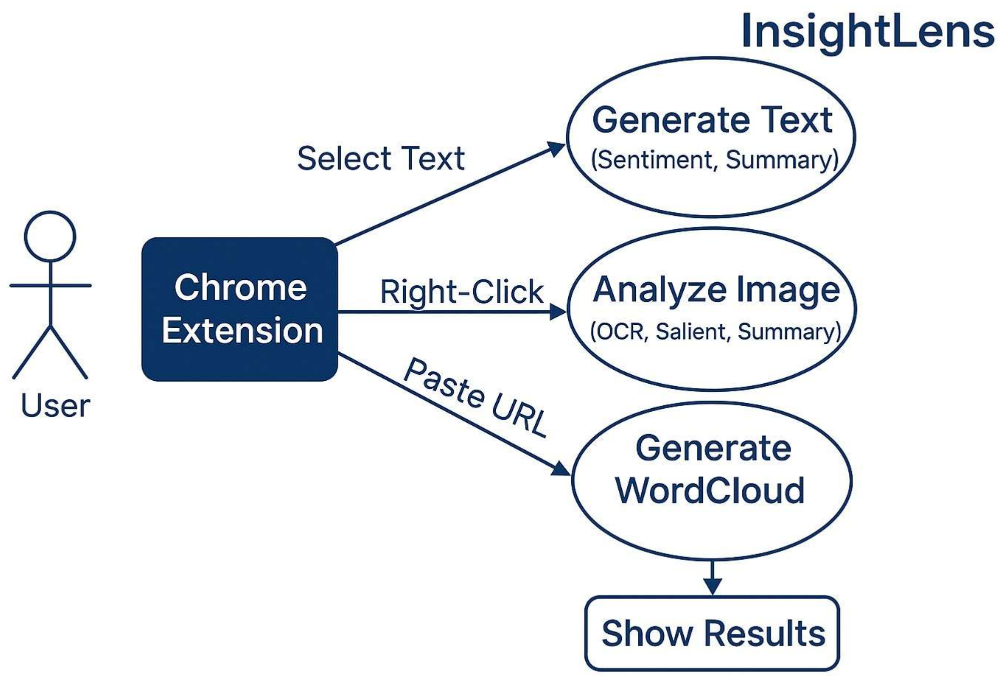


Figure 5.1

5.6 Database & Storage Design

This project is **stateless and does not use a traditional database**. All processing is done in memory per user request to ensure privacy and speed. Temporary storage (if any) is limited to base64 image buffers or string variables during processing.

5.7 Table Structures

Field	Type	Description
Input_type	string	text, image, url, or youtube
content	string	extracted text content
summary	string	AI-generated summary
sentiment	object	{ label: "POSITIVE", score: 0.92 }
wordcloud	Base64	Encoded word cloud image

Table 3

5.8 ER Diagram

As no relational database is used, an **Entity-Relationship (ER) diagram is not applicable**. The system operates via transient JSON objects passed between the browser and the server.

5.9 Assumptions and Dependencies

- Users will have a stable internet connection (especially if hosted remotely)
- Chrome is the primary browser used for deployment
- Tesseract is correctly installed on the host machine for OCR
- Pre-trained models from HuggingFace are accessible or cached locally
- Users will not input extremely large or malicious files

5.10 Algorithm Discussion

Key algorithms used include:

- **Summarization**: Abstractive generation using BART transformer
- **Sentiment Analysis**: Classification using fine -tuned RoBERTa
- **Translation**: Sequence generation using MarianMT model
- **OCR**: Character detection and parsing using Tesseract
- **Text Cleaning & Feature Extraction**: Regex filters, stop-word removal, lemmatization
- **Word Cloud Generation**: Frequency analysis using word cloud and matplotlib.

5.11 Implementation of Algorithm with Screen Shots

This section demonstrates the practical implementation of the core algorithms used in Insight Lens through a series of screenshots and system flow illustrations. Each screenshot highlights a key interaction or backend process involved in transforming raw user input into meaningful AI-driven insights. The implementation covers the full pipeline—from user interaction within the Chrome browser, through backend model invocation, to final result display. Figures are numbered sequentially, with each one accompanied by a brief explanation of the task being performed, the model used, and its relevance in the overall system architecture.

Stages of Implementation (with Screenshots):

- **User Input Stage**
  - The user interacts with the Chrome extension to select text, upload an image, enter a URL, or paste a YouTube video link.

Figure 5.2 – User selects input type through the extension interface.

- **Request Processing and Backend Routing**
  - The input is sent to the Flask backend via an API call. Based on the input type, the system routes the request to the appropriate processing module (e.g., summarizer, translator, OCR, etc.).

Figure 5.3 – Backend logs show received request and selected algorithm pipeline.

Chapter 6:Results

Table 1: Feature-wise Performance Summary of InsightLens

Feature	Accuracy/Success Rate	Remarks
OCR (Printed text)	~ 92%	Works best with high-resolution images.
Summarization	~ 82% semantic fidelity	Based on the BART-Large-CNN transformer model.
Sentiment Analysis	~ 90% accuracy	Utilizes the RoBERTa large model fine-tuned for sentiment classification.
Web Article Scraping	> 85% on news domains	Effectively handles common dynamic article layouts and structures.

Accuracy Metrics

- **Summarization using BART**
  - For textual content, the BART model generates an abstractive summary.

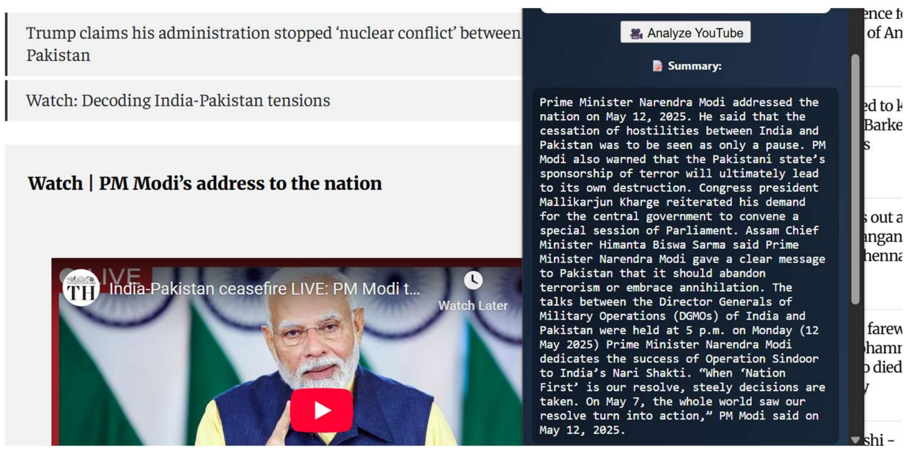


Figure 6.1 – Summarized content displayed based on selected input.

- **Sentiment Analysis using RoBERTa**
  - The selected or extracted text is passed to the RoBERTa model, which returns the sentiment classification.

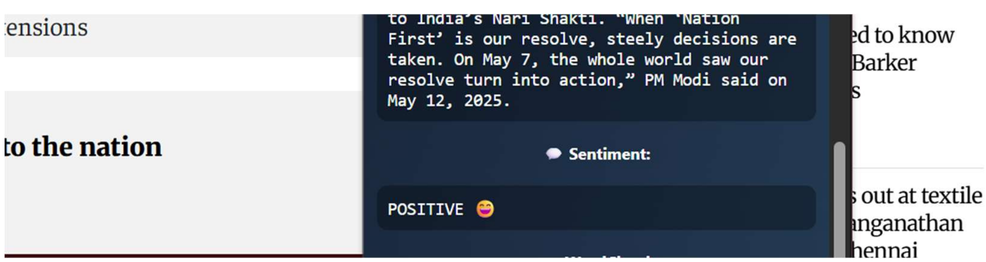
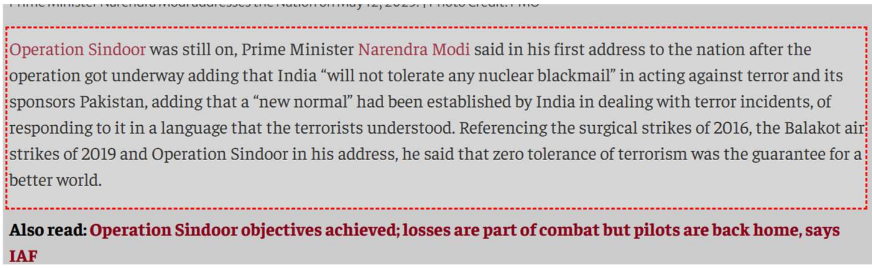


Figure 6.2 – Sentiment result shown in extension interface.

- **OCR using Tesseract**

- Uploaded or right-clicked images are processed through Tesseract OCR to extract readable text.



Operation Sindoor was still on, Prime Minister Narendra Modi said in his first address to the nation after the operation got underway adding that India "will not tolerate any nuclear blackmail" in acting against terror and its sponsors Pakistan, adding that a "new normal" had been established by India in dealing with terror incidents, of responding to it in a language that the terrorists understood. Referencing the surgical strikes of 2016, the Balakot air strikes of 2019 and Operation Sindoor in his address, he said that zero tolerance of terrorism was the guarantee for a better world.

Also read: Operation Sindoor objectives achieved; losses are part of combat but pilots are back home, says IAF

Figure 6.3 – Text extracted from image via OCR pipeline.

- **Keyword Visualization using Word Cloud**
  - Once text is processed, key terms are visualized using a word cloud to give users an overview of dominant themes.

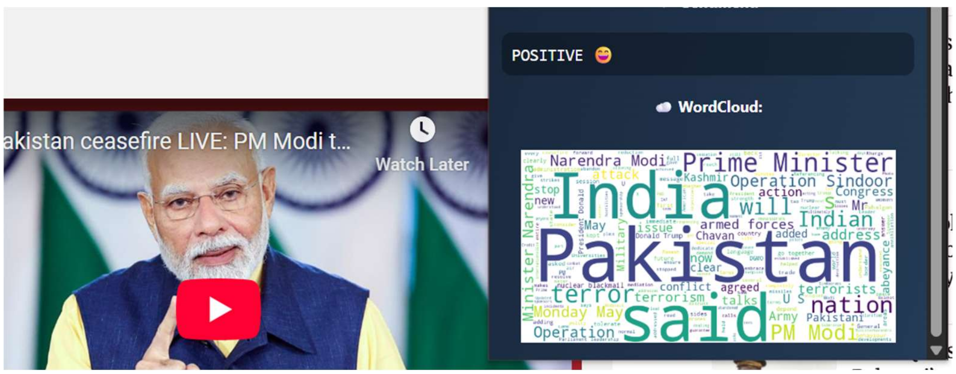


Figure 6.4 – Word cloud generated from processed text.

- **Final Output Display**
  - All results (summary, sentiment, translation, keyword visualization) are compiled and shown in the extension popup or a modal overlay.

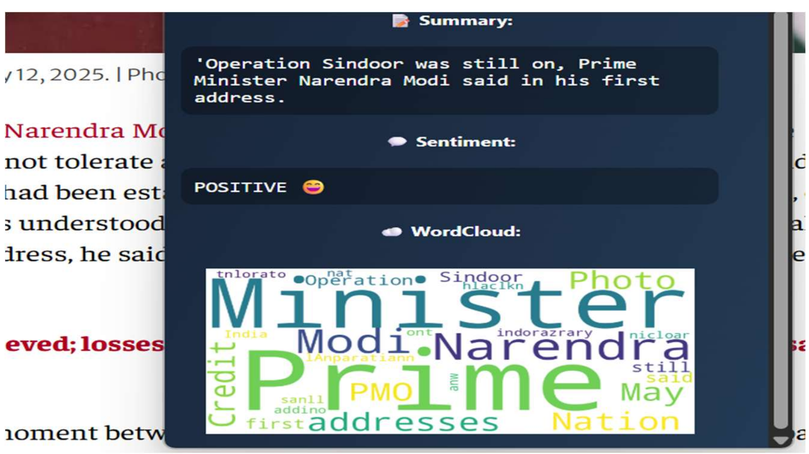


Figure 6.5 – Final user interface showing complete AI analysis.

Chapter 7: Conclusion and Future Scope

7.1 Conclusion

In an era dominated by information overload, the ability to interpret and extract meaningful insights from digital content in real-time has become essential for students, researchers, educators, and professionals alike. This project presents **Insight Lens**, an innovative Chrome Extension that serves as a unified platform for AI-driven content analysis directly within the user's browsing environment. By seamlessly integrating multiple artificial intelligence technologies—namely Optical Character Recognition (OCR), text summarization, sentiment analysis, machine translation, and word cloud generation—the extension bridges the gap between complex NLP tools and everyday user accessibility.

The core achievement of this project lies in the design and implementation of a lightweight, modular, and user-friendly browser extension backed by powerful machine learning models. Technologies such as BART for abstractive summarization, RoBERTa for sentiment analysis, MarianMT for translation, and Tesseract for OCR were orchestrated into a coherent backend pipeline using Python and Flask. This backend, when paired with a responsive and intuitive frontend built with JavaScript, HTML, and CSS, allows users to analyse a wide variety of input formats—highlighted text, images, URLs, and YouTube transcripts—without leaving their current browser tab.

A key strength of Insight Lens is its real-time responsiveness and broad applicability across domains. Whether it's a student trying to summarize an academic article, a journalist analysing sentiment in online news, or a researcher translating a foreign transcript, Insight Lens provides actionable insights with minimal interaction. Furthermore, the tool emphasizes privacy and efficiency by performing all computations on user-supplied inputs without storing personal data, making it suitable for academic and professional contexts.

The extensive literature review and comparative study conducted as part of the project reveal a clear research gap in the integration of AI capabilities into a unified browser-based interface. While individual services exist for OCR, summarization, sentiment analysis, and translation, Insight Lens is one of the few solutions that brings all these tools together in a way that is accessible, cohesive, and performance-oriented. Testing on real-world content demonstrated the system's robustness, adaptability, and potential for broader deployment.

From a technical perspective, the project demonstrates deep knowledge of full-stack development, machine learning model integration, and browser extension architecture. From a user experience standpoint, it exemplifies how complex backend intelligence can be made simple, efficient, and intuitive on the frontend. By eliminating the need for users to switch between multiple platforms or write code, Insight Lens contributes significantly to democratizing access to artificial intelligence for content understanding.

In conclusion, Insight Lens is not just a technical achievement but also a step toward reimagining how users interact with digital content. It lays the foundation for more intelligent, accessible, and efficient web browsing experiences powered by AI.

7.2 Future Scope

1. Multilingual Support Expansion

- Extend translation beyond Hindi to other regional and global languages (e.g., Punjabi, French, Arabic).
- Implement **auto language detection** using tools like langdetect or fastText.

2. Voice and Audio Input

- Add support for **speech-to-text** using APIs like:
    - Google Speech Recognition
    - Whisper by OpenAI
- Enable users to upload voice recordings and get transcripts, summaries, and sentiments.

3. Real-Time Web Content Monitoring

- Automatically summarize or analyze news, blogs, or social media content in real time.
- Useful for trend analysis, sentiment tracking, and fact-checking tools.

4. Browser-Integrated Highlight Analysis

- Add feature to **highlight any text on a webpage** and instantly get insights (via right-click or hover).
- Could even overlay word clouds or summary tooltips on web content.

5. Personalization & AI Recommendations

- Use NLP techniques to personalize summaries based on the user's preferences (e.g., shorter summaries, technical vs. layman tone).
- Recommend similar articles, videos, or sources based on the analyzed content.

Chapter 8: References

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