COMSATS University Islamabad

Abbottabad, Pakistan

VideoVigil: Violence Detection in Videos

By

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Supervisor

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Bachelor of Science in Software Engineering (2020-2024)

The candidate confirms that the work submitted is their own and appropriate credit has been given where reference has been made to the work of others.

COMSATS University Islamabad, Pakistan

VideoVigil: Violence Detection in Videos

A project presented to

COMSATS University Islamabad, Abbottabad Campus

In partial fulfillment

of the requirement for the degree of

Bachelor of Science in Software Engineering (2020-2024)

By

Mubashir Ahmed CIIT/FA20-BSE-063/ATD

DECLARATION

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<u>CERTIFICATE OF APPROVAL</u>

It is to certify that the final year project of BS (SE) “VideoVigil: Violence Detection in Videos” was developed by **MUBASHIR AHMED (CIIT/FA20-BSE - 063)**, under the supervision of “**Ma’am Neeli Khan**” and that in his opinion; it is fully adequate, in scope and quality for the degree of Bachelor of Science in Software Engineering.

EXECUTIVE SUMMARY

VideoVigil is a pioneering project aimed at enhancing online safety and safeguarding mental well-being by developing a specialized web browser extension to detect violent content within online videos. With a focus on real-time video analysis and violence detection, VideoVigil utilizes cutting-edge deep learning models to proactively identify and warn users about potentially distressing content.

The project's foundation lies in successfully implementing a real-time human detection module using the YOLO V8 model, establishing a robust framework for the subsequent development phases. VideoVigil adopts a procedural design methodology, leveraging an iterative and incremental process model to ensure adaptability and continuous improvement throughout development.

Recognizing the severe consequences of exposure to graphic violence, particularly on vulnerable demographics like children and adolescents, VideoVigil integrates seamlessly into web browsers, actively scanning videos across various platforms. Unlike traditional content moderation tools reliant on manual reporting or basic keyword-based algorithms, VideoVigil stands out for its innovative approach to automated violence detection.

Moreover, VideoVigil addresses inherent challenges in deep learning model development, such as computational expense and biases, by striving to create an efficient, trainable, and deployable model while meticulously curating datasets to minimize biases. By doing so, VideoVigil not only contributes to advancing online safety but also raises awareness about the dangers of online violence and promotes responsible internet usage.

The project offers valuable opportunities for learning and skill development in deep learning model creation, dataset curation, and browser extension development, making it a significant endeavor in the current digital landscape. VideoVigil's commitment to efficiency, effectiveness, and responsibility underscores its potential to make a tangible difference in mitigating users' exposure to harmful online content.

In conclusion, VideoVigil represents a groundbreaking initiative poised to revolutionize online safety measures, providing users with a proactive defense against violent content while fostering a culture of responsible internet usage.

ACKNOWLEDGEMENT

All praise is to Almighty Allah who bestowed upon us a minute portion of His boundless knowledge by virtue of which we were able to accomplish this challenging task.

We are greatly indebted to our project supervisor “Mam Neeli Khan” without their personal supervision, advice and valuable guidance, completion of this project would have been doubtful. We are deeply indebted to them for their encouragement and continual help during this work.

And we are also thankful to our parents and family who have been a constant source of encouragement for us and brought us the values of honesty & hard work.

ABBREVIATIONS

ABBREVIATION	**MEANING**
API	Application Programming Interface
SDLC	Software Development Life Cycle
SRS	Software Requirement Specification
SDD	Software Design Description
TPU	Tensor Processing Unit
ML	Machine Learning
DL	Deep Learning
CNN	Conventional Neural Networks
R-CNN	Regional Conventional Neural Networks
NLP	Natural Language Processing
DNN	Deep Neural Networks
SQE	Software Quality Assurance

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1. Introduction

This chapter serves as an introductory overview of the Video Vigil project. It outlines the key objectives and scope of the project, emphasizing the significance of developing a specialized web browser extension for detecting violent content within online videos. By offering a summary at the beginning of each chapter, readers gain insights into the content covered, facilitating a structured understanding of the project's progression and findings. Through this introductory chapter, readers are acquainted with the project's aim to enhance online safety and mental well-being by leveraging advanced technology and responsible internet practice.

1.1. Brief

The VideoVigil project endeavors to address the critical concern of online violence and sensitive content portrayed in videos, posing substantial risks to users' mental well-being. Through the development of a robust deep learning model, the project aims to autonomously detect instances of violence in videos and issue warnings to users, enabling them to make informed decisions about their viewing experiences. Deployed as a web browser extension, this innovative solution offers easy accessibility and enhances online safety for users. Leveraging advanced deep learning technology and meticulously curated datasets, the project tackles challenges such as computational expense and biases. Adopting an iterative and incremental methodology, the project ensures continuous improvement and adaptation to evolving challenges in model development and dataset curation.

Used Agile software methodology for this project to develop a VideoVigil system that can detect violence in videos. Agile is a software development methodology that emphasizes iterative development, teamwork, and adaptability. It is well-suited for complex projects, such as my own, because it allows for changes to be made quickly and easily.

The outcome of the VideoVigil project is a sophisticated deep learning model deployed as a web browser extension, effectively detecting instances of violence within online videos in real-time and empowering users with timely warnings. By enhancing online safety and content moderation, the project contributes to fostering a safer and more considerate online environment for users.

Utilizing advanced deep learning techniques, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs), the VideoVigil project develops the violence detection model. Tools such as Yolo and PyTorch are employed for model training and deployment. Embracing an iterative and incremental methodology, the project facilitates continuous improvement and adaptation to evolving challenges in model development and dataset curation.

Throughout the project, comprehensive discussions revolve around various aspects, including the critical problem of online violence and sensitive content, the proposed solution utilizing advanced deep learning technology, challenges such as computational expense and biases, and proposed solutions focusing on dataset curation and bias mitigation. The project concludes by underscoring its contributions to enhancing online safety and promoting responsible internet usage, emphasizing the value of the developed deep learning model and web browser extension in creating a safer online environment for users.

1.2. Relevance to Course Modules

The VideoVigil system is built upon the solid foundation established by various course modules from the comprehensive four-year BSE program. The project heavily draws upon concepts from Machine Learning and Artificial Intelligence, utilizing advanced deep learning models and algorithms such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) to detect violence in videos with remarkable accuracy. Data Science techniques, including data preprocessing, feature extraction, and data analysis, are also essential components of the project, enabling the effective processing and analysis of large datasets. Furthermore, the Agile methodology, learned in Software Engineering courses, guides the development process, allowing for continuous improvement, adaptability, and flexibility in response to changing requirements.

Moreover, Computer Vision techniques, including image processing, object detection, and video analysis, are skillfully utilized to analyze video content and detect violent behavior. Considering the sensitive nature of the project, ethical considerations, discussed in Ethics in Computing courses, are paramount in ensuring responsible technology use, privacy protection, and bias mitigation. Web Development skills, acquired in relevant courses, enable the seamless deployment of VideoVigil as a user-friendly web browser extension. Finally, Software Project Management principles, learned in the corresponding course, facilitate effective time and resource management, planning, scheduling, and team collaboration, ensuring the successful development and implementation of the project.

1.3. Project Background

The VideoVigil project stems from the escalating concern surrounding online violence, particularly its impact on users' mental well-being. Studies reveal that a significant portion of adolescents, approximately 60%, have encountered violence online, leading to adverse effects such as anxiety and depression. Recognizing the efficacy of deep learning models in detecting violence in videos, with reported accuracies as high as 95%, the project seeks to leverage this technology to mitigate the proliferation of harmful content online.

However, several challenges hinder the widespread adoption of deep learning models for violence detection. Primarily, these models often incur substantial computational costs during training and deployment phases. Additionally, biases inherent in the training data can influence model performance, leading to inaccurate or skewed results. To address these challenges, the VideoVigil project aims to develop a deep learning model optimized for efficiency in both training and deployment. Moreover, meticulous curation of the dataset will be undertaken to minimize biases, ensuring the model's reliability and effectiveness in detecting online violence.

1.4. Literature Review

The proliferation of online violence and sensitive content in videos has spurred various initiatives and solutions aimed at mitigating its adverse effects on users' mental well-being. In this literature review, we examine existing trends, research, and products related to online content moderation, particularly focusing on video vigilance applications. ChildSafe Video, while an attempt to safeguard children from harmful content, has faced criticism for its perceived ineffectiveness in filtering out violence adequately. To address this weakness, our project proposes enhancing ChildSafe Video by integrating advanced deep learning models. These models will leverage techniques such as video content analysis, motion detection, and audio processing to identify violence more accurately and effectively, thereby providing enhanced protection for young users. StreamGuard, a platform primarily reliant on metadata and user reporting, has been criticized for its potential delays in responding to violent content. Our project aims to improve StreamGuard by incorporating real-time video analysis and machine learning algorithms. By leveraging these technologies, StreamGuard can promptly detect and flag violent content as it appears, thereby minimizing exposure to harmful material and enhancing user safety. WebSearch Shield utilizes traditional rule-based filters for violence detection, which may lead to false positives and false negatives. To address this limitation, our proposed project offers a more sophisticated approach. By employing deep neural networks and natural language processing techniques, we aim to refine violence content filtering in WebSearch Shield. This approach will enhance the accuracy of content moderation, reducing false alarms and ensuring a safer browsing experience for users.

1.5. Analysis from Literature Review

ChildSafe Video, a content filtering system, has faced criticism for its ineffectiveness in detecting and filtering out violent content. To address this shortcoming, our project aims to significantly enhance ChildSafe Video's capabilities by integrating advanced deep learning models. These models will meticulously analyze video content, motion, and audio to identify violent behavior with greater accuracy, enabling more effective filtering and protection for users. StreamGuard, another content moderation system, relies heavily on metadata and user reporting to detect violent content. However, this approach can lead to delayed responses, allowing harmful content to persist. Our project seeks to improve

StreamGuard's efficiency by incorporating real-time video analysis and machine learning algorithms. These advancements will enable prompt detection and flagging of violent content, reducing the risk of exposure and ensuring a safer user experience. WebSearch Shield, a filtering system, utilizes traditional rule-based filters to detect violent content. However, these filters often produce false positives and false negatives, compromising their effectiveness. Our proposed project offers a more sophisticated approach, leveraging deep neural networks and natural language processing to refine violence content filtering. By reducing false alarms and improving accuracy, our enhanced system will provide a more reliable and efficient solution for detecting and filtering violent content.

1.6. Methodology and Software Lifecycle for This Project

For this project, we have selected the Agile framework as our methodology and software lifecycle model. This approach is well-suited for software development projects that require flexibility and adaptability to changing requirements.

The Agile framework allows for iterative and incremental development, where requirements and solutions evolve through the collaborative effort of self-organizing and cross-functional teams. This approach enables us to quickly respond to changes in customer needs or project requirements, as well as address any issues or defects that arise during development.

1.6.1. Rationale behind Selected Methodology

The choice of the agile framework was selected as the methodology for this project due to its flexibility, adaptability, and iterative approach. As this is a final year project, it is important to have a methodology that can easily accommodate changes and feedback from stakeholders. The agile framework allows for frequent review and adaptation of the project plan, which is particularly useful in a dynamic and complex project like this. Additionally, the framework promotes collaboration, communication, and teamwork among project members, which is crucial in ensuring the success of the project.

2. Problem Definition

This chapter provides a comprehensive overview of the specific problem that needs to be addressed. Additionally, it expands upon the desired outcome to be achieved.

2.1. Problem Statement

The browser extension we are developing addresses the critical issue of online violence and sensitive content within videos, which can have severe repercussions on users' mental well-being. This system's primary objective is to autonomously detect such content and issue warnings to users, empowering them to make informed decisions regarding their video consumption. The motivation behind this project stems from the growing need for enhanced online safety, particularly on internet platforms, where users encounter a multitude of videos daily.

While various content moderation tools exist, a comprehensive solution for automatically identifying and flagging potentially distressing videos is not widely accessible. Many existing systems rely on manual reporting or basic keyword-based algorithms, which leaves room for harmful content to evade detection. Our browser extension stands out by harnessing the power of deep learning to autonomously identify violent content, thereby improving online safety for users. The project's uniqueness lies in its potential deployment as a browser extension, ensuring easy accessibility for a wide user base. The re-implementation of such a system offers an invaluable opportunity for learning. It provides practical experience in developing, training, and deploying deep learning models for real-world applications. Additionally, it fosters proficiency in browser extension development, a highly relevant and sought-after skill in today's digital landscape.

Through this project, we anticipate gaining proficiency in various areas. This includes expertise in deep learning model development, encompassing data preprocessing, model architecture design, and optimization. We also expect to acquire skills in dataset curation and bias mitigation, recognizing the paramount importance of a balanced and unbiased dataset.

2.2. Deliverables and Development Requirements

The VideoVigil web browser extension necessitates a precise set of technical specifications to guarantee seamless development and optimal functionality. The extension's core architecture will be built using JavaScript, HTML, and CSS, harnessing the strengths of these languages to craft a user-centric and interactive interface. Specifically, JavaScript will be employed for dynamic client-side scripting, HTML will provide the structural foundation, and CSS will ensure a visually appealing and responsive design. Moreover, a sophisticated deep learning model will be developed using Python, in conjunction with powerful deep learning frameworks such as TensorFlow or PyTorch, to enable advanced video analysis and violence detection capabilities. To facilitate efficient development, an Integrated Development Environment (IDE) like Visual Studio will be utilized, providing a comprehensive suite of tools for coding, debugging, and testing. Additionally, exhaustive documentation will be created using Microsoft Word, PowerPoint, and Star UML, ensuring that all aspects of the project, including technical specifications, architecture, and user manuals, are thoroughly documented. The primary programming languages used throughout the project will be Python, JavaScript, and CSS, each chosen for their unique strengths and suitability for the task at hand, with Python serving as the backbone for the deep learning model, JavaScript driving the extension's dynamic functionality, and CSS ensuring a polished user interface.

2.3. Current System

ChildSafe Video, despite its noble goal of safeguarding children from harmful content, has faced significant criticism for its perceived ineffectiveness in filtering out violent material. The current system often allows harmful content to slip through, compromising the safety of young viewers. This shortfall is largely due to the limitations in its content filtering algorithms, which primarily rely on basic keyword detection and user reports, methods that are not sophisticated enough to catch all instances of violent content. To address these significant weaknesses, our project proposes a comprehensive enhancement of ChildSafe Video by integrating advanced deep learning models.

These models will employ sophisticated techniques such as video content analysis, motion detection, and audio processing to identify violence with higher accuracy and effectiveness. Specifically, we will use convolutional neural networks (CNNs) and recurrent neural networks (RNNs) to analyze video frames and sequences. CNNs are highly effective for image recognition tasks and can be trained to detect violent scenes by recognizing patterns and anomalies in the video frames. RNNs, particularly Long Short-Term Memory (LSTM) networks, are excellent for sequence prediction tasks and can analyze the temporal aspects of videos, such as sudden movements or aggressive gestures, to detect violence more reliably. By combining CNNs and RNNs, our system will be able to detect both subtle and overt violent behaviors, providing a more robust safeguard for children.

In addition to visual analysis, our system will incorporate advanced audio processing techniques to analyze sound patterns and detect auditory cues associated with violence, such as shouting, gunshots, and explosions. This multi-modal approach, which combines visual and auditory data, will significantly enhance the system’s ability to identify violent content accurately.

StreamGuard, another content moderation system, relies heavily on metadata and user reporting, which leads to delayed responses to violent content and potentially exposes users to harmful material. Metadata, such as titles and descriptions, can be misleading or incomplete, and user reporting is reactive rather than proactive, often resulting in a time lag before harmful content is flagged and removed. Our project aims to address these limitations by integrating real-time content analysis using deep learning models, which will allow for immediate detection and removal of violent content.Moreover, WebSearch Shield, which primarily focuses on filtering harmful web content, also suffers from similar shortcomings. It relies on keyword filtering and blacklists, which are not foolproof methods for detecting all instances of harmful content. Our proposed system will extend its capabilities by incorporating advanced natural language processing (NLP) techniques to analyze the context and semantics of web content more accurately. This will enable the system to detect and filter out harmful content even if it is disguised with benign keywords or phrases.

By addressing the critical weaknesses of these existing content moderation systems, our project aims to significantly improve their efficacy and enhance the protection of young users from violent content. Through the integration of advanced deep learning models and multi-modal analysis techniques, we will create a more robust and reliable system that can proactively safeguard children from exposure to harmful material.

3. Requirement Analysis

We will be using Use cases as our requirement identifying technique to help derive functional requirement specifications. Use cases are effective for our project as it is an interactive end-user application. The requirement analysis of the whole system architecture is present in this chapter.

3.1. Use Cases Diagram(s)

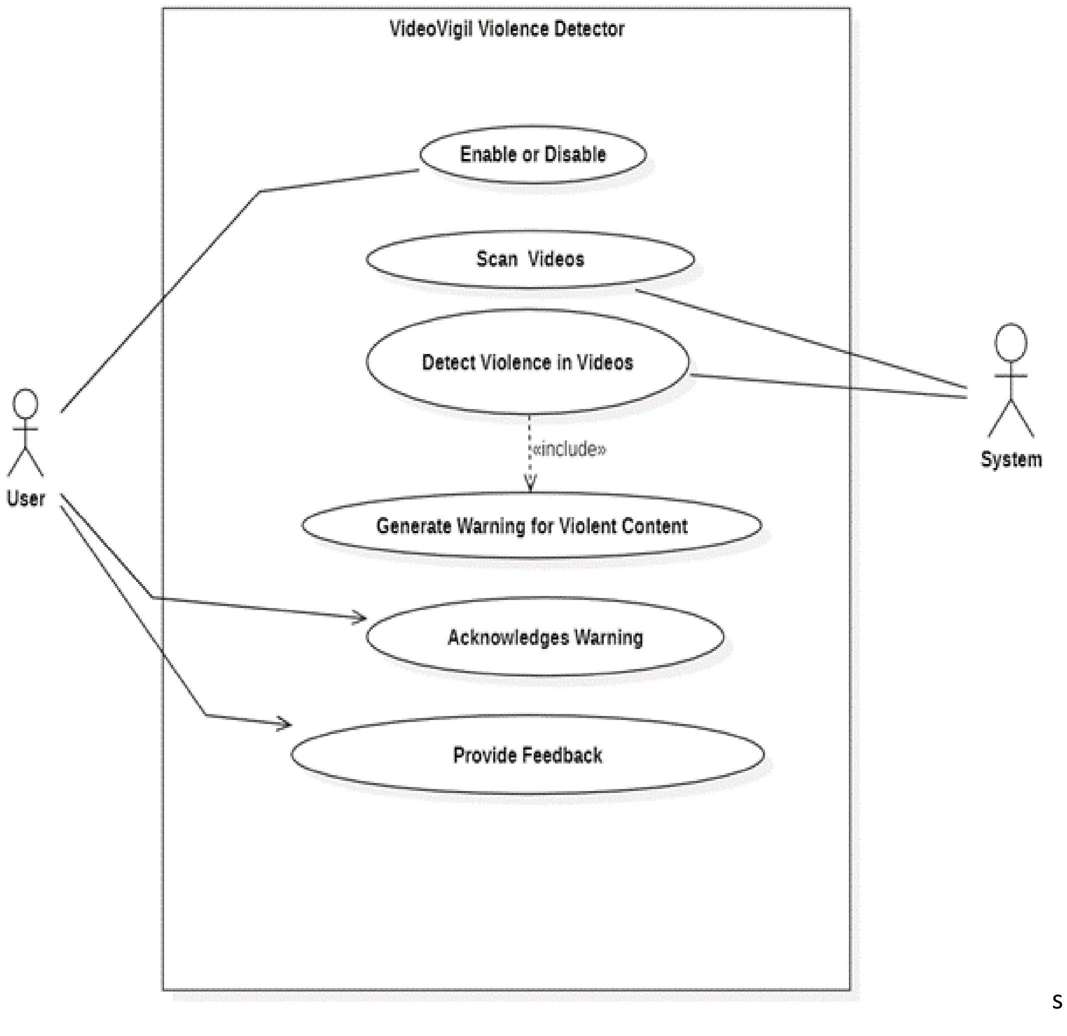

VideoVigil Violence Detector
Enable or Disable
Scan Videos
Detect Violence in Videos
«include»
Generate Warning for Violent Content
Acknowledges Warning
Provide Feedback
User
System
s

Fig 3.1 Use Case diagram

The use case diagram illustrates the functionalities of a video vigilance detector system designed to automatically detect violence in videos. The system initiates its operation by conducting a real-time scan of the video for visual cues indicative of violence, such as blood, weapons, or aggressive motion. Upon identifying potential violence, the system generates a warning for the user, who can then acknowledge the alert and take appropriate actions, such as stopping the video or reporting it.The key actors in this system include the System, responsible for real-time video scanning; Video, providing input for analysis.

3.2. Detailed Use Case

Table 3.1 Enable or Disable Detail Use Case

Use Case ID:	UC-1
Use Case Name:	Enable or disable
Actors:	User (Primary Actor)
Description:	User: Wants to control the operation of the violence detection feature based on requirements and context. System: Ensures the accurate switching on/off of functions and respects user preferences.
Trigger:	User must turn on the extension to have warning.
Preconditions:	1. The user has access to the system's control interface.
Post conditions:	The system's violence detection feature is either enabled or disabled.
Normal Flow:	1. User navigates to the control interface. 2. User selects the option to either enable or disable the violence detection. 3. The system updates the functionality status based on the user selection. 4. System confirms the status update to the user.
Alternative Flows:	None.
Exceptions:	None.
Business Rules	The user must be using the YouTube web.
Assumptions:	The user knows how to use the extensions.

Table 3.2 Scan Video Detail Use Case

Use Case ID:	UC-2
Use Case Name:	Scan Video
Actors:	System (Primary Actor), User (Secondary Actor)
Description:	The User initiates the video scanning process through a machine learning-based browser extension. The system scans the video content for potentially violent or inappropriate scenes and generates warnings if such content is detected. The system automatically scans and analyzes the video content to detect any scenes of violence.
Trigger:	The User activates the video scanning feature in the browser extension.
Preconditions:	1. The User has the machine learning-based browser extension installed and activated. 2. The video content is accessible and supported by the extension. 3. Videos are being scanned, and instances of violence are identified.
Post conditions:	1. The system generates warnings for any detected violent or inappropriate content. 2. Violent content is accurately flagged.
Normal Flow:	1. The User activates the video scanning feature in the browser extension. 2. The extension initiates the video scanning process using the Machine Learning Model. 3. The Machine Learning Model analyzes the video content for violent or inappropriate scenes. 4. If violent content is detected: 5. If no violent content is detected, the process concludes without warnings.
Alternative Flows:	None
Exceptions:	None
Business Rules	None
Assumptions:	None

Table 3.3 Detect Violence in Video Detail Use Case

Use Case ID:	UC-3
Use Case Name:	Detect Violence in Video
Actors:	System (Primary Actor), User (Secondary Actor)
Description:	The User initiates the video scanning process through a machine learning-based browser extension. The system scans the video content for potentially violent or inappropriate scenes and generates warnings if such content is detected. The system accurately identifies and flags violent content within the videos.
Trigger:	The User initiates the video scanning process in the application.
Preconditions:	1. The User has the machine learning-based browser extension installed and activated. 2. The video content is accessible and supported by the extension. 3. Videos are being scanned.
Post conditions:	1. The system generates warnings for any detected violent or inappropriate content. 2. Violent content is accurately flagged.
Normal Flow:	1. The User activates the video violence detection feature in the application. 2. The application prompts the User to upload or select a video for analysis. 3. The Video Processing System uses the Machine Learning Model to analyze the video for violent scenes.
Alternative Flows:	None
Exceptions:	If the device connection fails, the system displays an error message, and the user can retry the process.
Business Rules	The user must be logged in to connect a new device.
Assumptions:	The user has the necessary device and understands the Wi-Fi connection process.

3.3. Functional Requirements

Table 3.4 Video Analysis and Detection Functional Requirement

Identifier	FR-01
Title	Video Analysis and Detection
Requirement	The extension shall have the ability to analyze online videos in real-time.
Source	User Requirement
Rationale	To provide users with real-time insights and content analysis for better user experience and safety.
Business Rule (if required)	None
Dependencies	None
Priority	High

Table 3.5 Violence Detection Mechanism Functional Requirement

Identifier	FR-02
Title	Violence Detection Mechanism
Requirement	It shall implement a violence detection mechanism using a deep learning model.
Source	User Requirement
Rationale	To automatically identify and flag potentially violent content to protect users.
Business Rule (if required)	None
Dependencies	None
Priority	High

Table 3.6 Initial Human Detection Module Integration Functional Requirement

Identifier	FR-03
Title	Initial Human Detection Module Integration
Requirement	The initial human detection module, utilizing Faster R-CNN Inception V2 COCO, must seamlessly integrate with the violence detection process.
Source	Technical Design
Rationale	To ensure comprehensive detection capabilities by integrating advanced human detection with violence detection.
Business Rule (if required)	None
Dependencies	FR-001, FR-002
Priority	Medium

Table 3.7 Warning Message Generation Functional Requirement

Identifier	FR-04
Title	Warning Message Generation
Requirement	Upon detecting violent content in a video, the extension shall generate warning messages.
Source	User Safety Requirement
Rationale	To alert users about potentially distressing content and allow them to make informed decisions.
Business Rule (if required)	None
Dependencies	FR-001, FR-002
Priority	High

Table 3.8 Warning Message Clarity Functional Requirement

Identifier	FR-05
Title	Warning Message Clarity
Requirement	Warning messages should be clear, concise, and informative, advising users about potentially distressing content.
Source	User Experience
Rationale	To ensure that users understand the nature of the content and can act accordingly, enhancing their safety and experience.
Dependencies	FR-004
Priority	High

3.4. Non-Functional Requirements

The VideoVigil web browser extension must be designed with user-friendliness at its core. The extension should be intuitive and easy to navigate, ensuring that users with varying levels of technical proficiency can operate it without difficulty. This involves incorporating a simple, clear user interface with easily accessible features and straightforward navigation paths. Clear and concise instructions for each feature should be readily available within the extension, enhancing the user experience and facilitating efficient task completion. These instructions should include tooltips, user guides, and step-by-step tutorials to support users in effectively utilizing the extension. Furthermore, VideoVigil must prioritize accessibility to ensure that users with disabilities, including visual, hearing, and mobility impairments, can effectively interact with the extension. This includes implementing features such as screen reader compatibility, keyboard navigation, and adjustable text sizes to cater to a wide range of accessibility needs.

VideoVigil must be engineered for optimal performance to ensure a seamless user experience. The extension should load and execute rapidly, minimizing wait times and maintaining a smooth workflow for the user. It is crucial that VideoVigil can efficiently process a high volume of requests without experiencing significant delays, even during peak usage periods when user activity is at its highest. The system architecture should be robust and capable of handling concurrent processing tasks to maintain performance levels. Additionally, the extension should be capable of handling large datasets, such as extensive video libraries, to ensure robust performance in video scanning and analysis. This requires efficient data management and processing algorithms that can quickly and accurately analyze video content without degrading the user experience. VideoVigil must be designed for scalability and efficiency. The extension should be capable of supporting a large user base, ensuring that it can accommodate growth in the number of users without compromising performance. his involves designing the system architecture to distribute processing loads effectively and prevent bottlenecks.

4. Design and Architecture

The following parts of Software Design Description (SDD) report should be included in this chapter.

4.1. System Architecture

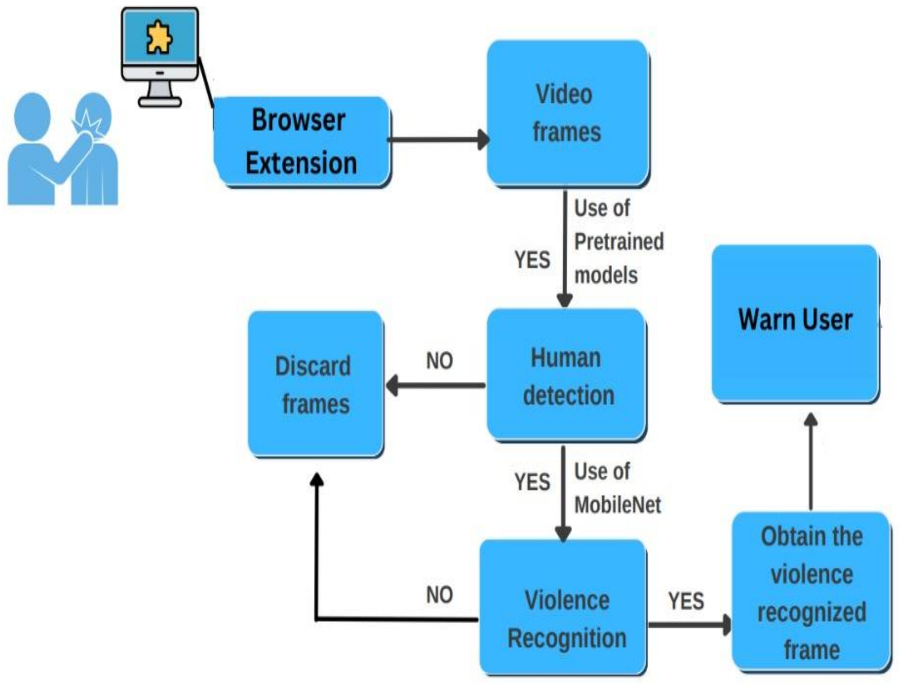


Fig 4.1 System Architecture

4.2. System Sequence Diagram

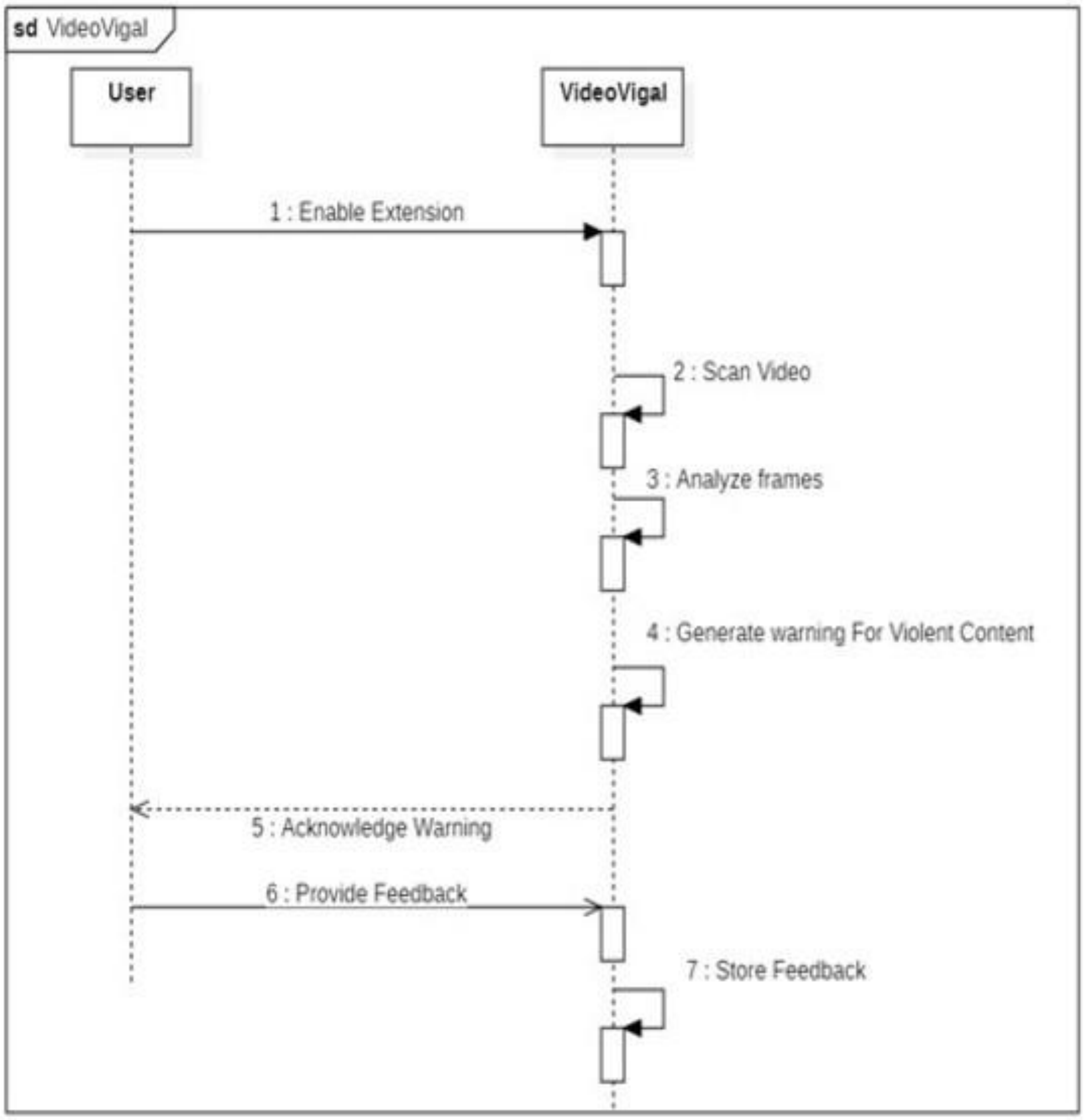


Fig 4.2 System Sequence Diagram

4.3. Process Flow/Representation

4.3.1. Activity Diagram

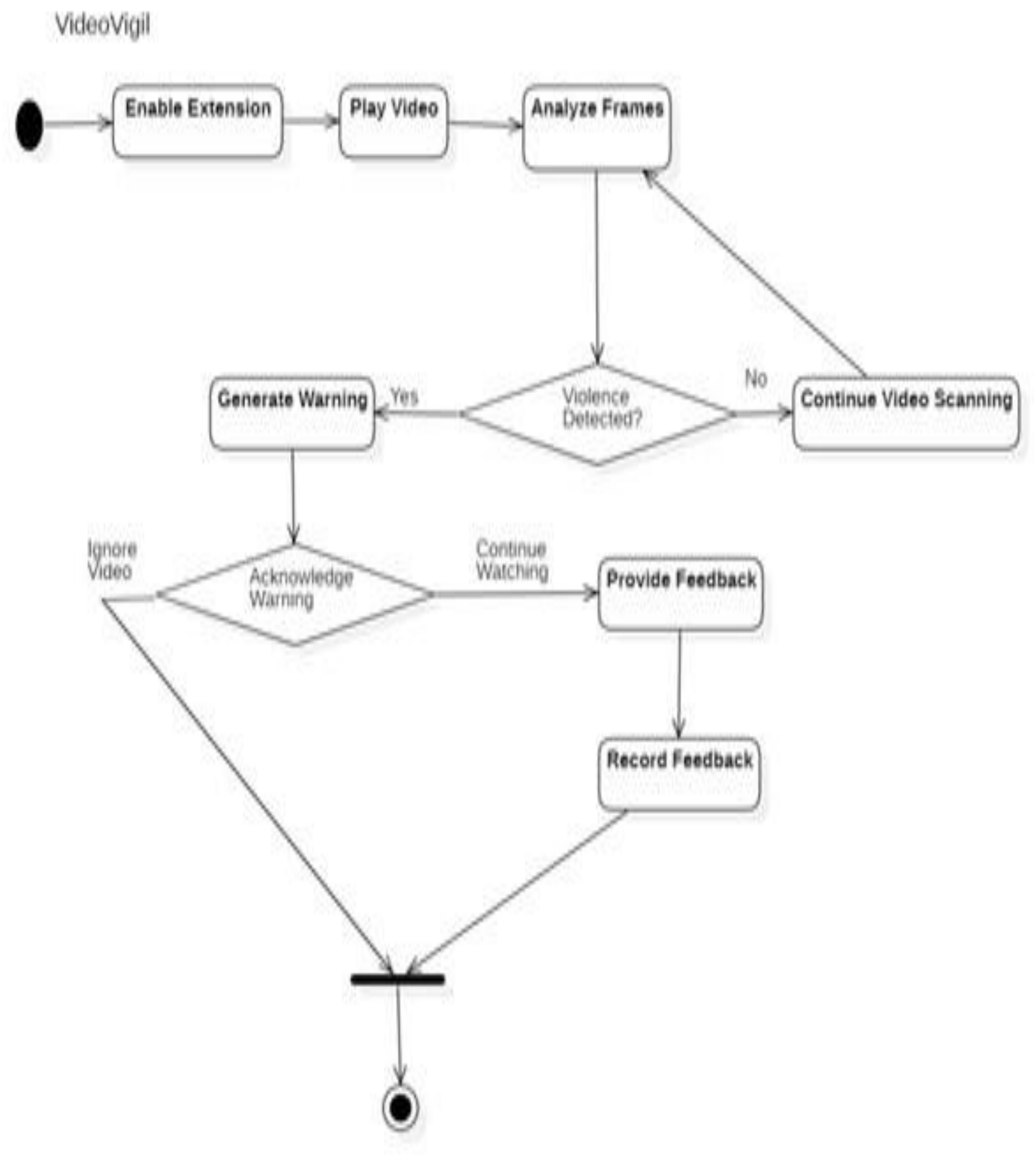


Fig 4.3 Activity Diagram

4.4. Design Models

4.4.1. Data Flow Diagram

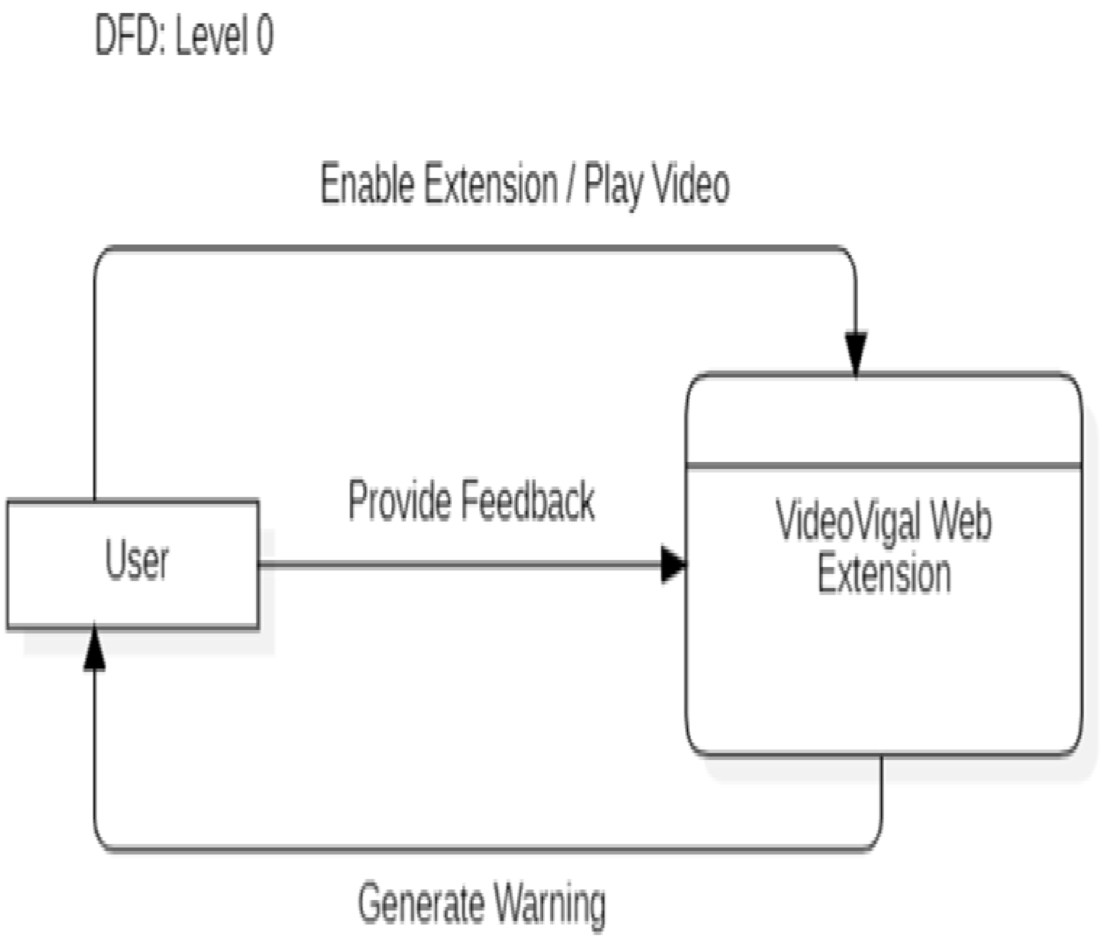


Fig 4.4 DFD Level 0 Diagram

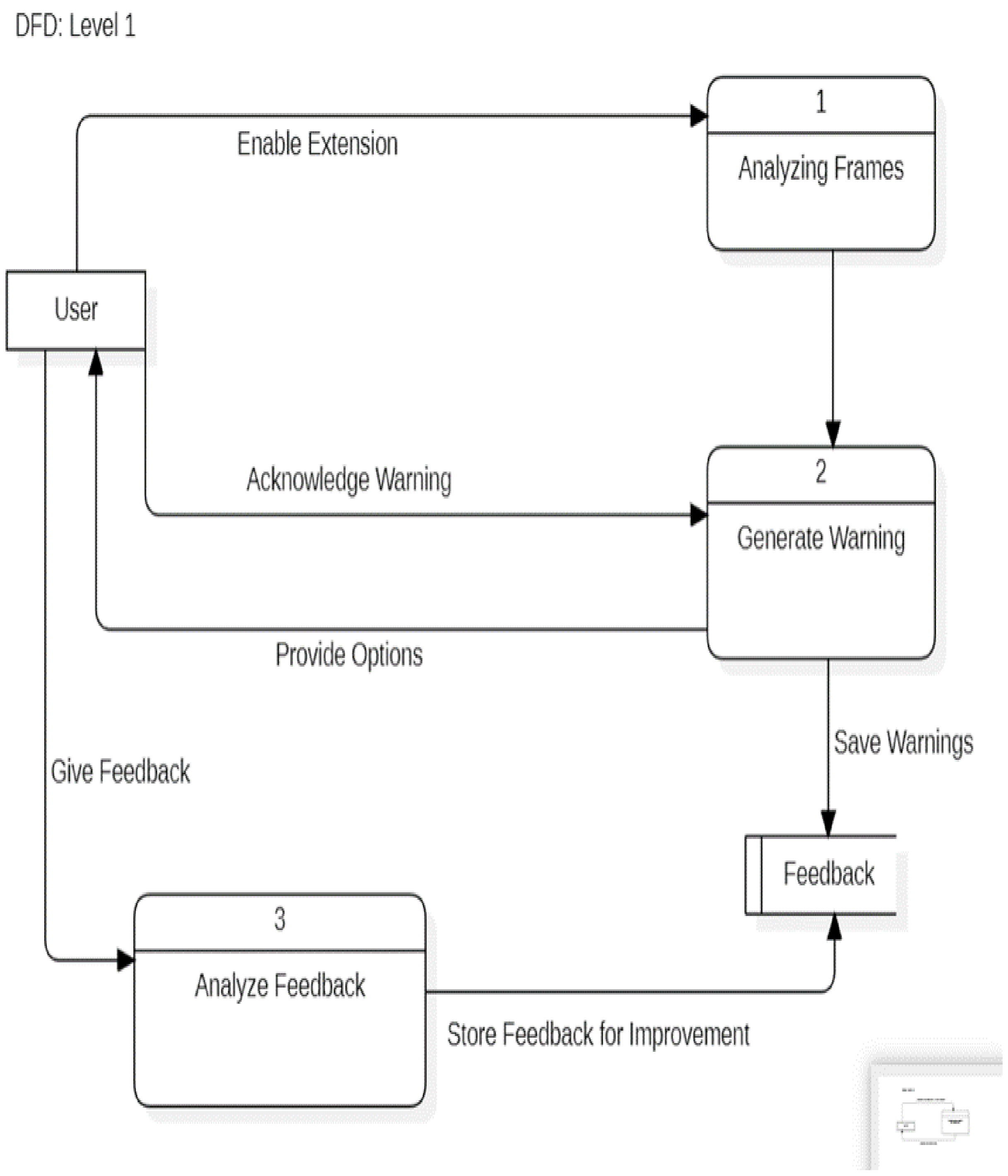


Fig 4.5 DFD Level 1 Diagram

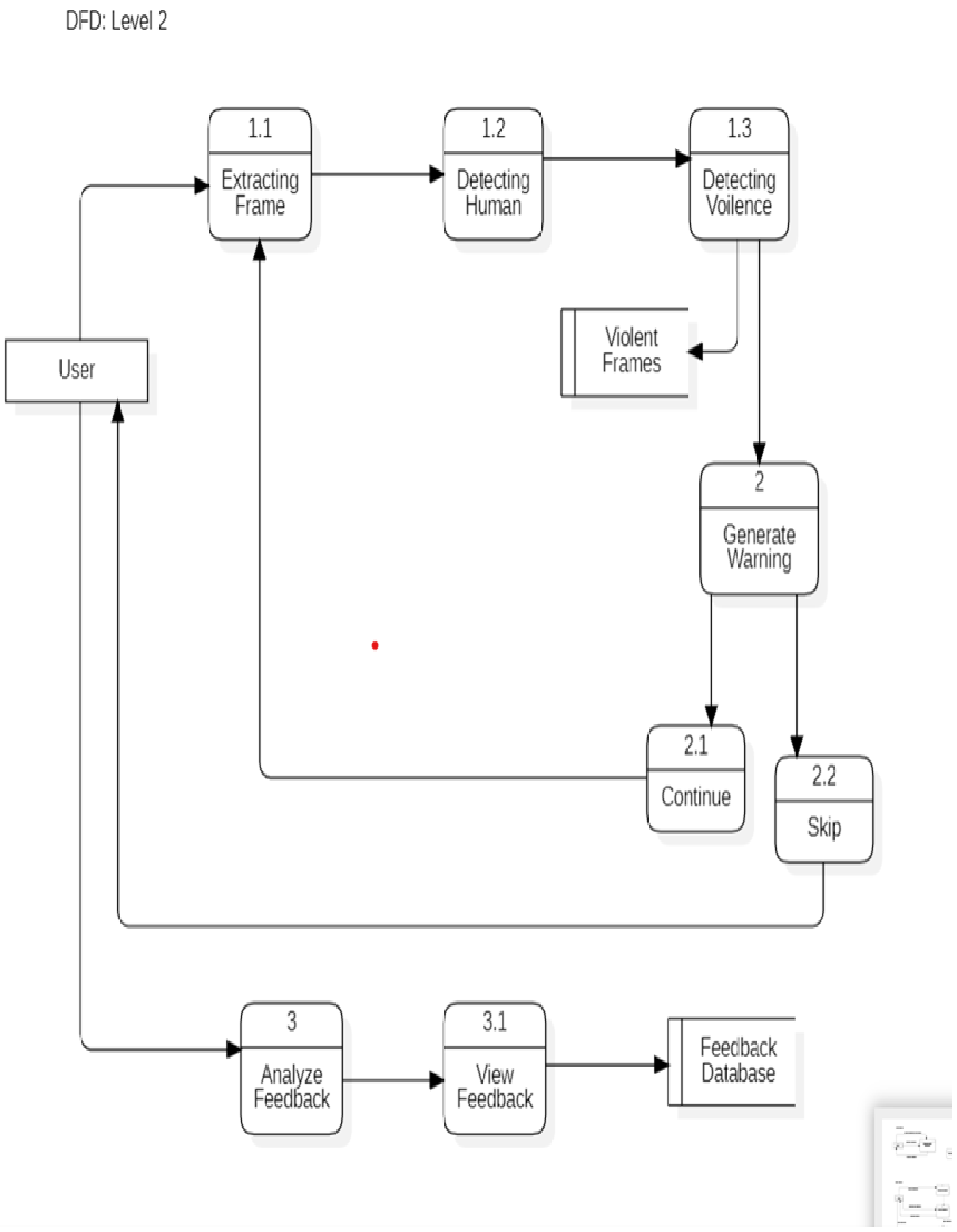


Fig 4.6 DFD Level 2 Diagram

4.4.2. Story Boards

4.4.2.1. Load Extension Story Board

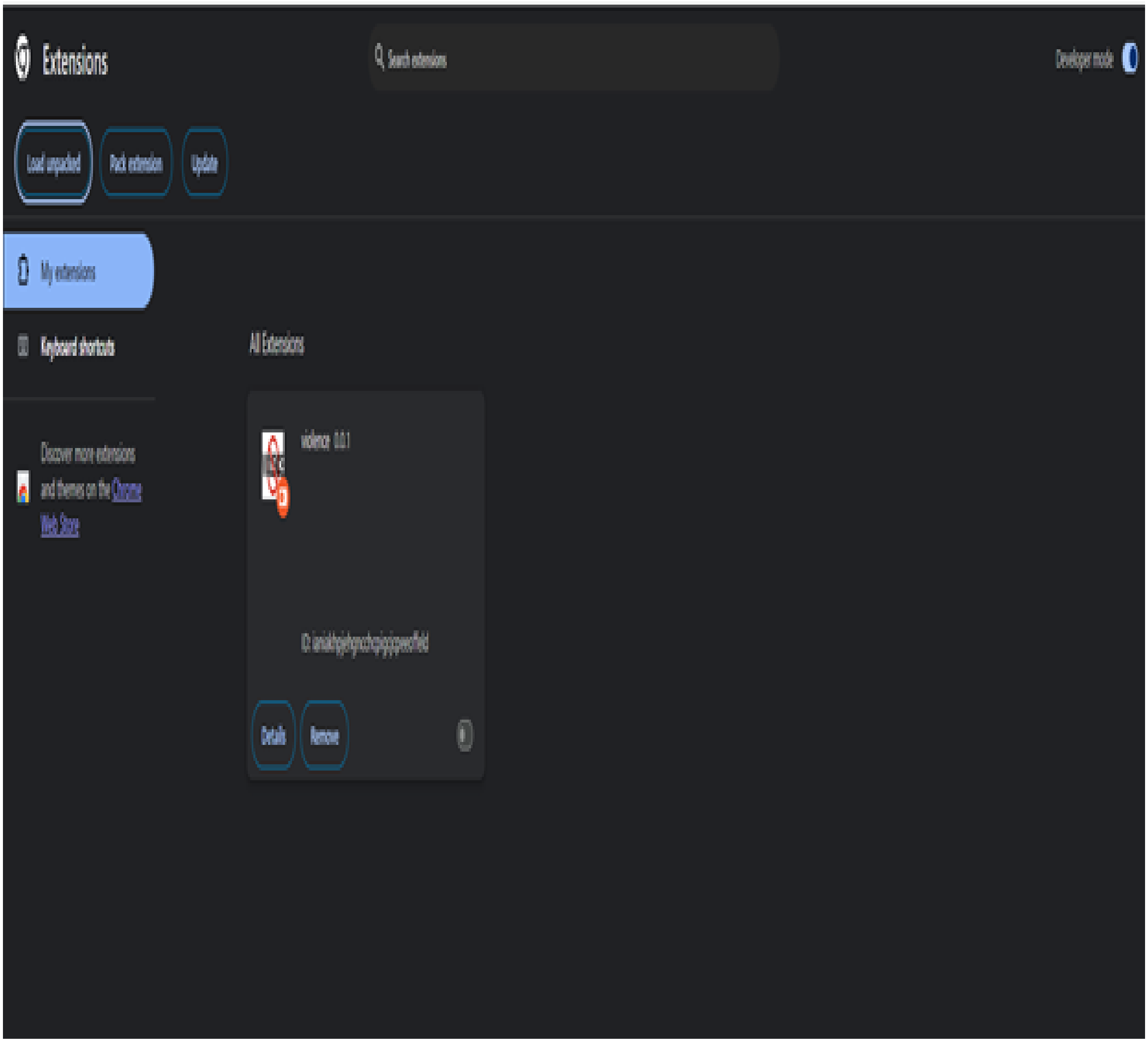
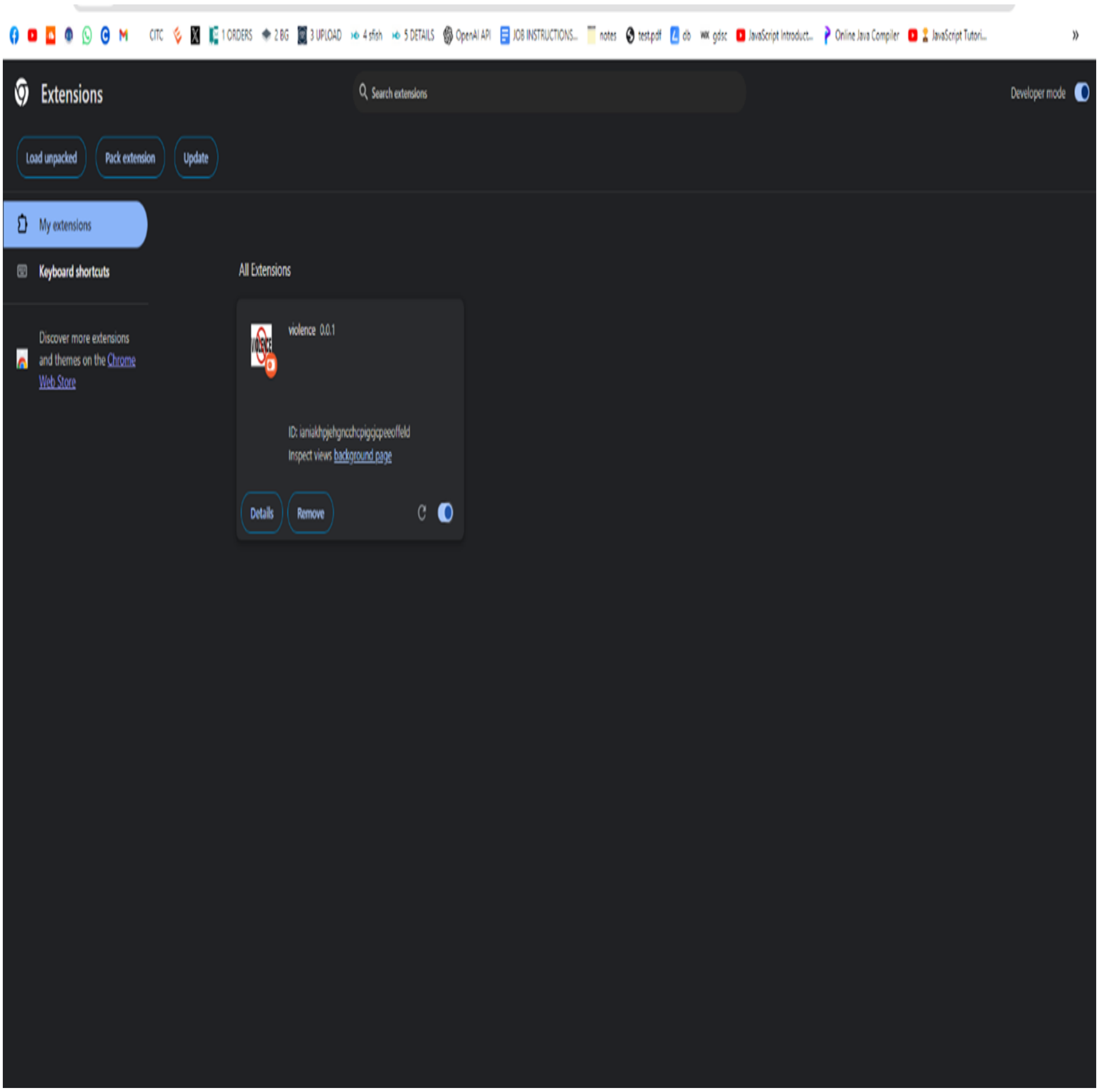


Fig 4.7 Load Extension Story Board

4.4.2.2. Turn On Extension Story Board



ID: ianiakhpjehgncchcpiggicpeeoffeld
Inspect views background page

Fig 4.8 Turn on Extension Story Board

4.4.2.3. Start Extension Story Board

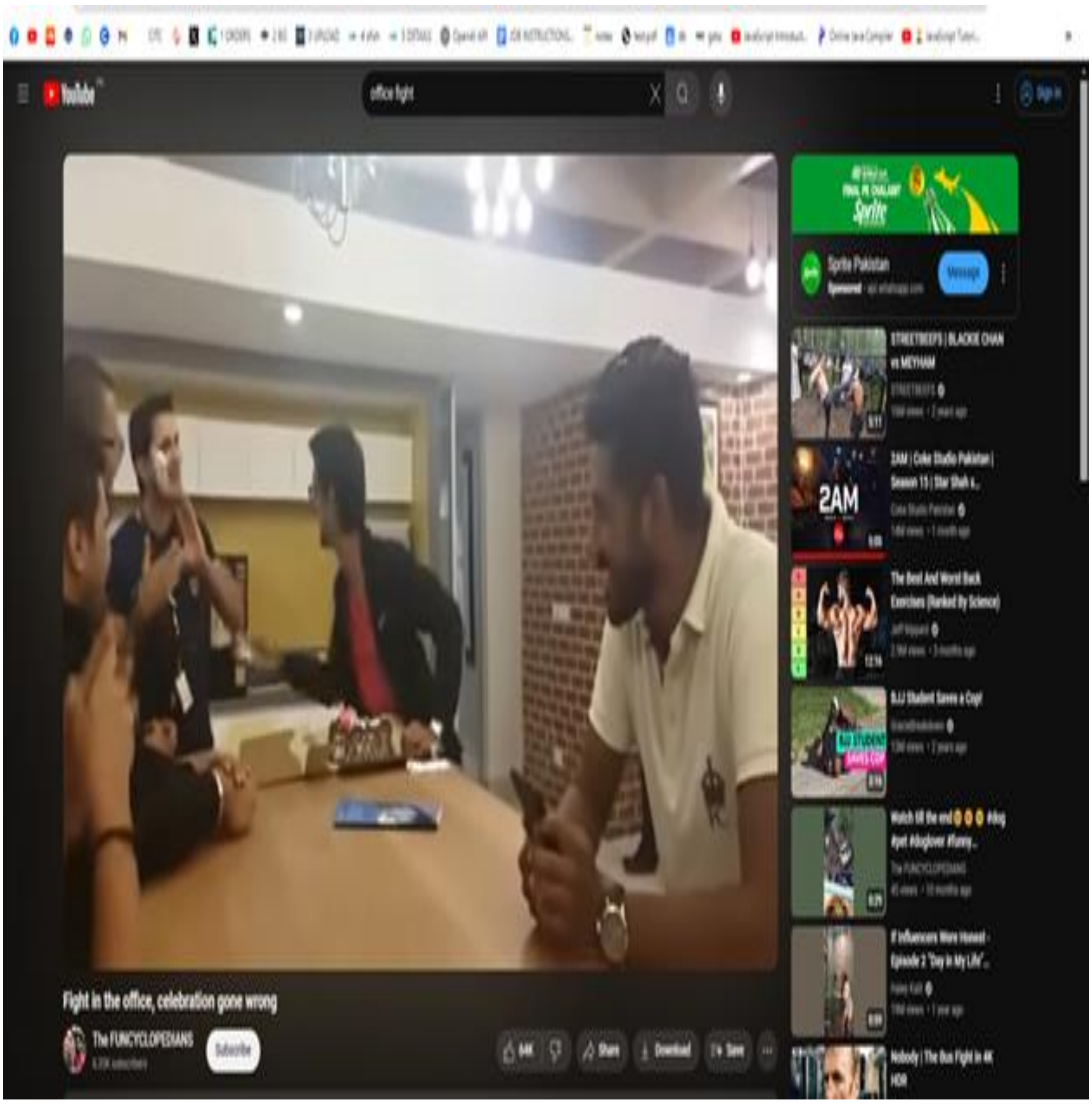

YouTube
office fight
Fight in the office, celebration gone wrong
The FUNCYCLOPEDIANS
Subscribe
Share
Download
Save
Sprite Pakistan
STREETBEEFS | BLACKIE CHAN vs MEYHAM
2AM | Coke Studio Pakistan | Season 15 | Star Shah x...
The Best And Worst Back Exercises (Ranked By Science)
BJJ Student Saves a Cop!
Nobody | The Bus Fight in 4K HDR

Fig 4.9 Start Extension Story Board

4.4.2.4. Check Warning Status Story Board

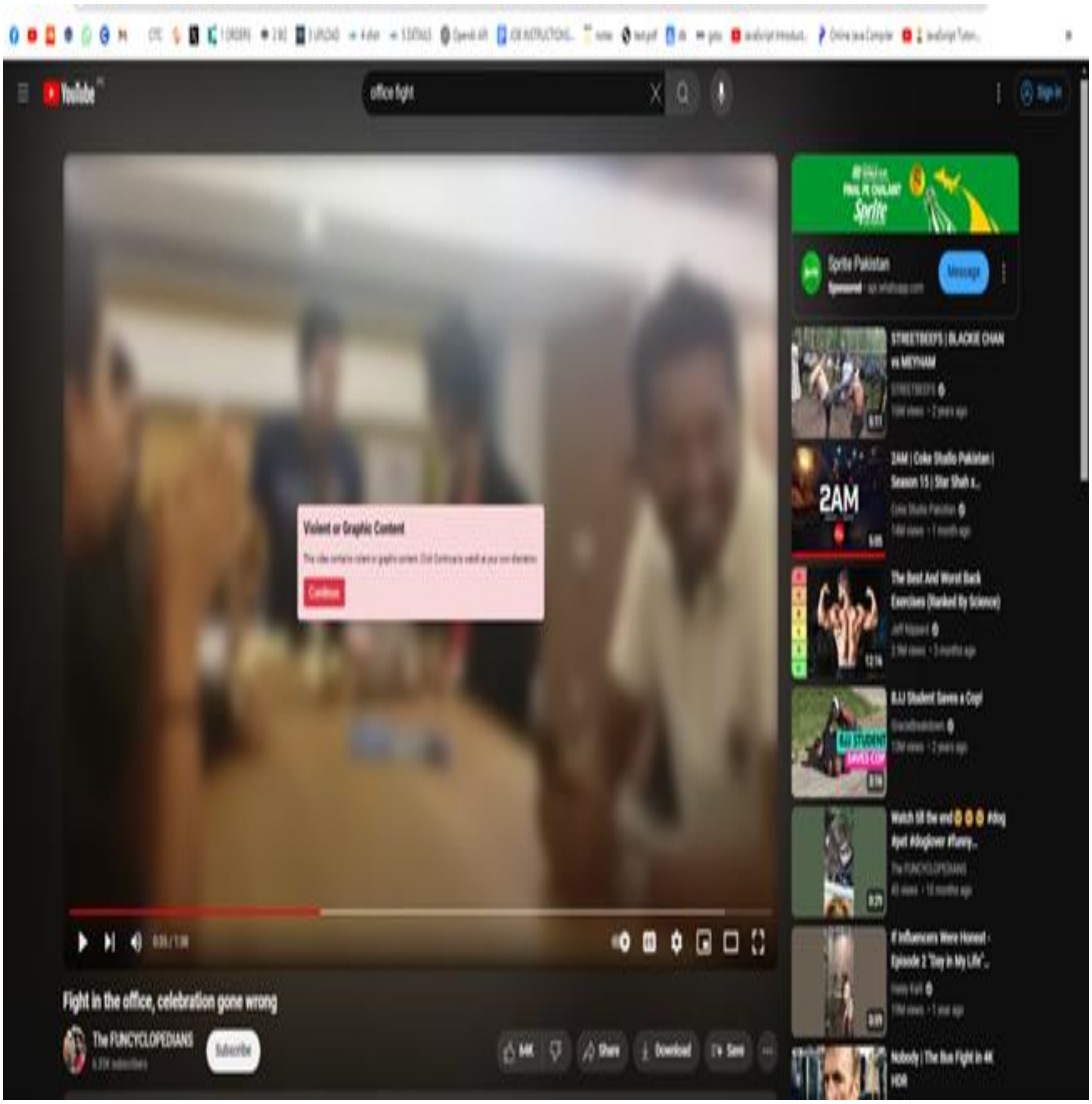

office fight
Violent or Graphic Content
Continue
Fight in the office, celebration gone wrong
The FUNCYCLOPEDIANS
Subscribe
Share
Download
Save

Fig 4.10 Check Warning Status Story Board

5. Implementation

5.1. Algorithm

Yolo v8 Detection:

- Open the video file and set up the video writer for output.
- Read each frame from the video.
- For each frame, apply the YOLO model to detect objects.
- If objects are detected with a confidence greater than the threshold:
- Render bounding boxes and labels on the frame.
- Write the processed frame to the output video.
- Release video resources and close all windows.
- Initialize the YOLO model with pre-trained weights and configuration files.
- Load the class labels that the YOLO model is trained to detect.
- Set the threshold for non-maxima suppression to filter out weak and overlapping bounding boxes.
- Convert the frame to a blob for YOLO input.
- Pass the blob through the YOLO model to obtain the output predictions.
- Extract the class IDs, confidences, and bounding boxes from the YOLO output.
- Apply non-maxima suppression to remove redundant overlapping boxes with lower confidences.
- Check if the detected object belongs to the classes of interest (e.g., violence-related objects).
- If the detected object is identified as relevant content, log the detection event with a timestamp.
- Display the processed frame with bounding boxes and labels in a window for real-time monitoring.
- Optionally, save metadata about the detected objects, such as class IDs, confidences, and bounding box coordinates, to a log file or database for further analysis.
- Periodically check if the video processing should stop, such as checking for user input or processing completion.
- Handle any exceptions or errors gracefully to ensure the processing loop can recover and continue.
- Release the video writer and any other resources when the processing is complete.

View py Main Detection:

- Decode user ID and token from URL.
- Check token validity and activate the user if valid.
- Create a new user with email and password.
- Return user data without the password.
- Delete user authentication token and logout the user
- Download video using yt-dlp.

- Run YOLO detection on the downloaded video.
- Return detection results or errors.
- Extract the token expiration time from the URL and check if it is still valid.
- Handle cases where the token is expired or invalid by returning an appropriate error message.
- Hash the user's password using a secure hashing algorithm before storing it.
- Store the user's email and hash password in the database.
- Generate a unique user ID and associate it with the newly created user.
- Send a confirmation email to the user with a link to verify their account.
- Ensure sensitive data, such as passwords, are never logged or exposed in responses.
- Use HTTPS for all communication to protect user data during transmission.
- Ensure the download directory for yt-dlp is properly secured and cleaned up after the download is complete.
- Verify the integrity of the downloaded video file before running YOLO detection.
- Load the YOLO model and prepare it for inference on the downloaded video.
- Log the start and completion times of the YOLO detection process for monitoring and performance analysis.
- Store detection results in a structured format such as JSON or a database for easy retrieval and analysis.
- Implement error handling to manage potential issues during video download or YOLO detection, providing informative error messages.
- Send a notification to the user upon completion of the detection process with a link to view the results.
- Ensure all temporary files and resources are cleaned up after the detection process is complete to maintain system performance.
- Implement rate limiting and security checks to prevent abuse of the video download and detection service.
- Regularly update the yt-dlp tool and YOLO model to benefit from the latest features and security patches.

Main Execution:

- Open video file.
- Set up video writer.
- Loop through frames
- Draw bounding box on frame.
- Add label and color to box.
- Create VideoVigilYOLO instance.
- Call detect_violence with input and output paths.
- Release resources.
- Close windows.
- Create VideoVigilYOLO instance.
- Call detect_violence with input and output paths.

- Initialize the video capture object with the input video file path.
- Configure the codec and parameters for the video writer to define the output video format.
- Iterate through each frame of the video in a loop until all frames are processed or the video ends.
- For each detected object, draw the bounding box on the frame using the coordinates provided by the YOLO model.
- Assign a specific color to the bounding box based on the type of detected object (e.g., red for violent content).
- Add a label to the bounding box indicating the type of detected object and the confidence score.
- Initialize the VideoVigilYOLO instance with the required model configuration and weights.
- Invoke the detect_violence method with the specified input and output video paths to start the detection process.
- After processing, release the video capture and writer resources to free up system memory.
- Close all OpenCV windows that were opened during the video processing for cleanup.
- Log the initialization and detection steps for debugging and performance monitoring purposes.
- Ensure exception handling to manage potential errors during video processing and resource release.
- Optionally, display the processed video in a window for real-time visualization during development and testing.
- Save metadata about the detection results, including timestamps and object details, for further analysis and reporting.
- Implement asynchronous processing to handle multiple video files concurrently, improving throughput and efficiency.
- Provide a user interface or API endpoint for triggering the video processing and retrieving results.
- Ensure compliance with privacy regulations by anonymizing any sensitive data included in the detection results.
- Optimize the video processing pipeline for performance, considering factors such as hardware acceleration and parallel processing.

Browser Status Monitoring:

- Receive input for monitoring requests, including user commands and device information.
- Check the status of the specified browser (PRINTVIEW) in the model.
- Return the real-time status of the device (e.g., "On" or "Off") to the user.

Device List Management:

- Receive input for viewing connected devices, including user commands.
- Retrieve the list of connected hardware devices from the system.
- Display the list to the user via the mobile app.
- Return the list of connected devices to the user.

5.2. External APIs

Table 5.1 Details of APIS

API	**Description**	**Purpose of Usage**	**Function/Class Name**
Flask	A micro web framework for Python.	To handle image and video detection and integration of modules	create_app(), analyze_video(), get_config(), update_config(), get_reports()
Django	A high-level Python web framework that encourages rapid development and clean, pragmatic design.	To manage user authentication, email handling, database interactions, and HTTP responses.	` activate, RegisterAPI, LogoutView, RunDetectionView
Rest_Framework	A powerful and flexible toolkit for building Web APIs in Django.	To handle API status codes, create viewsets, and return API responses.	RegisterAPI, LogoutView, RunDetectionView

5.3. User Interface

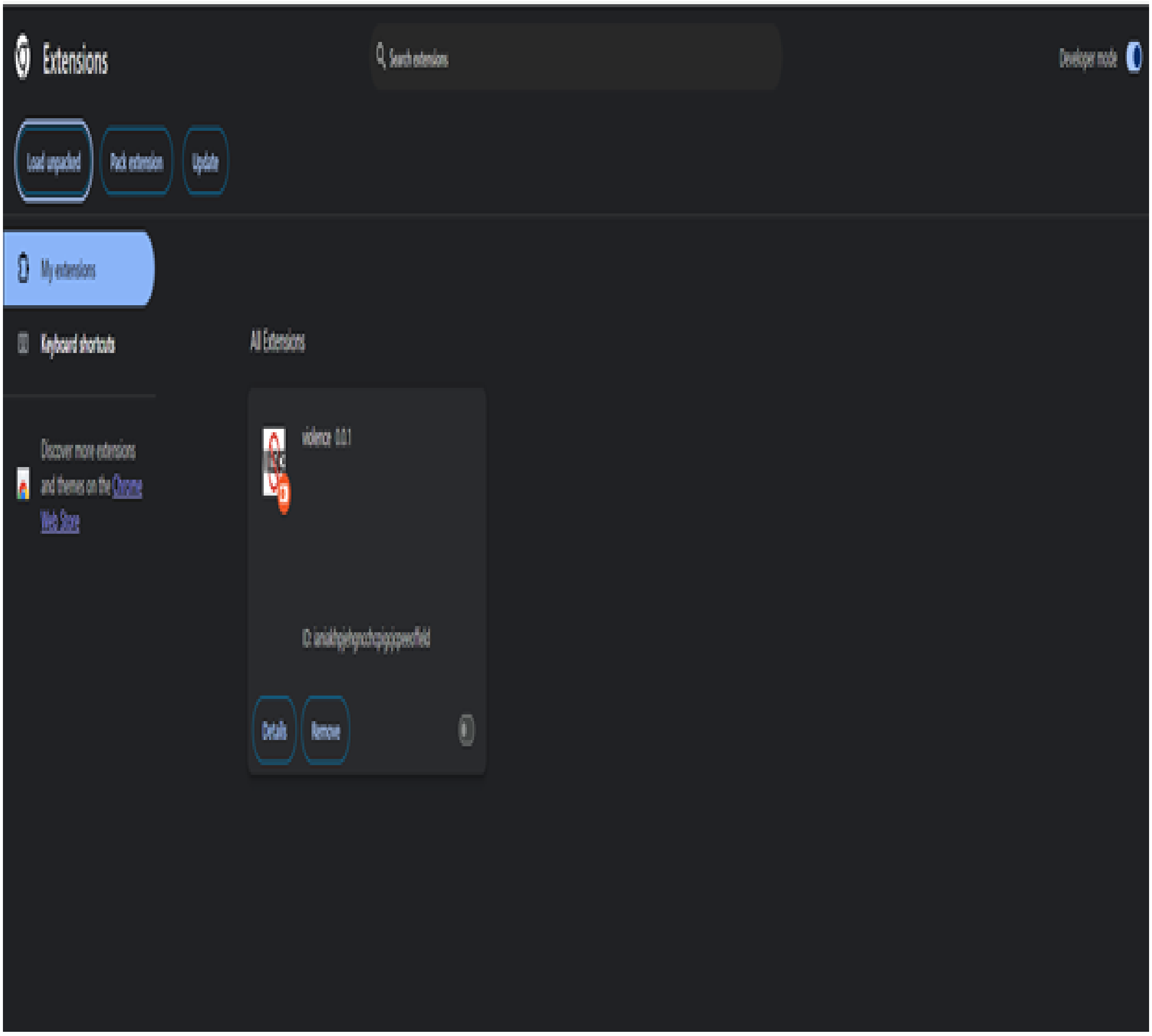


Fig 5.1 Turn On

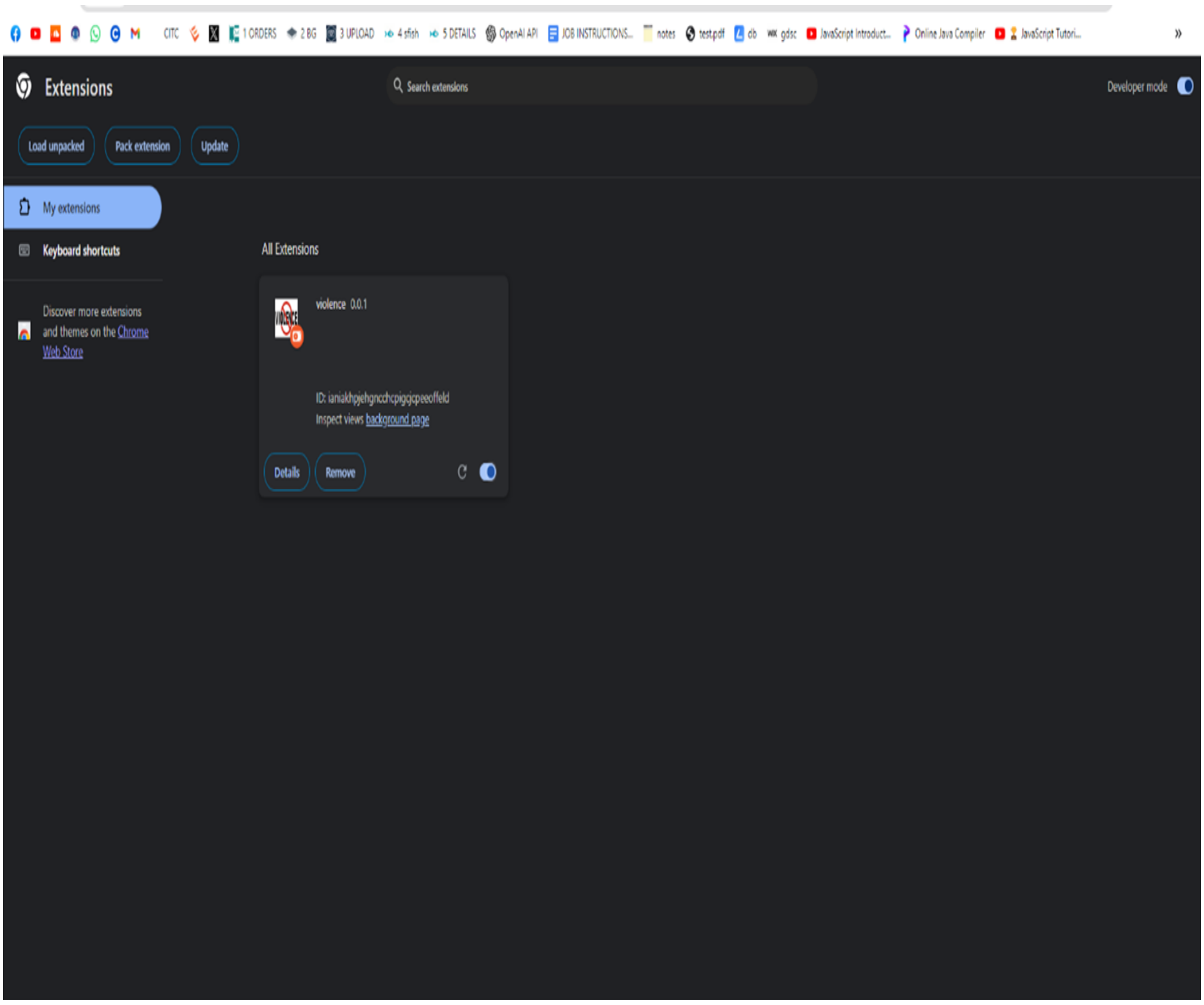


Fig 5.2 Developer Menu

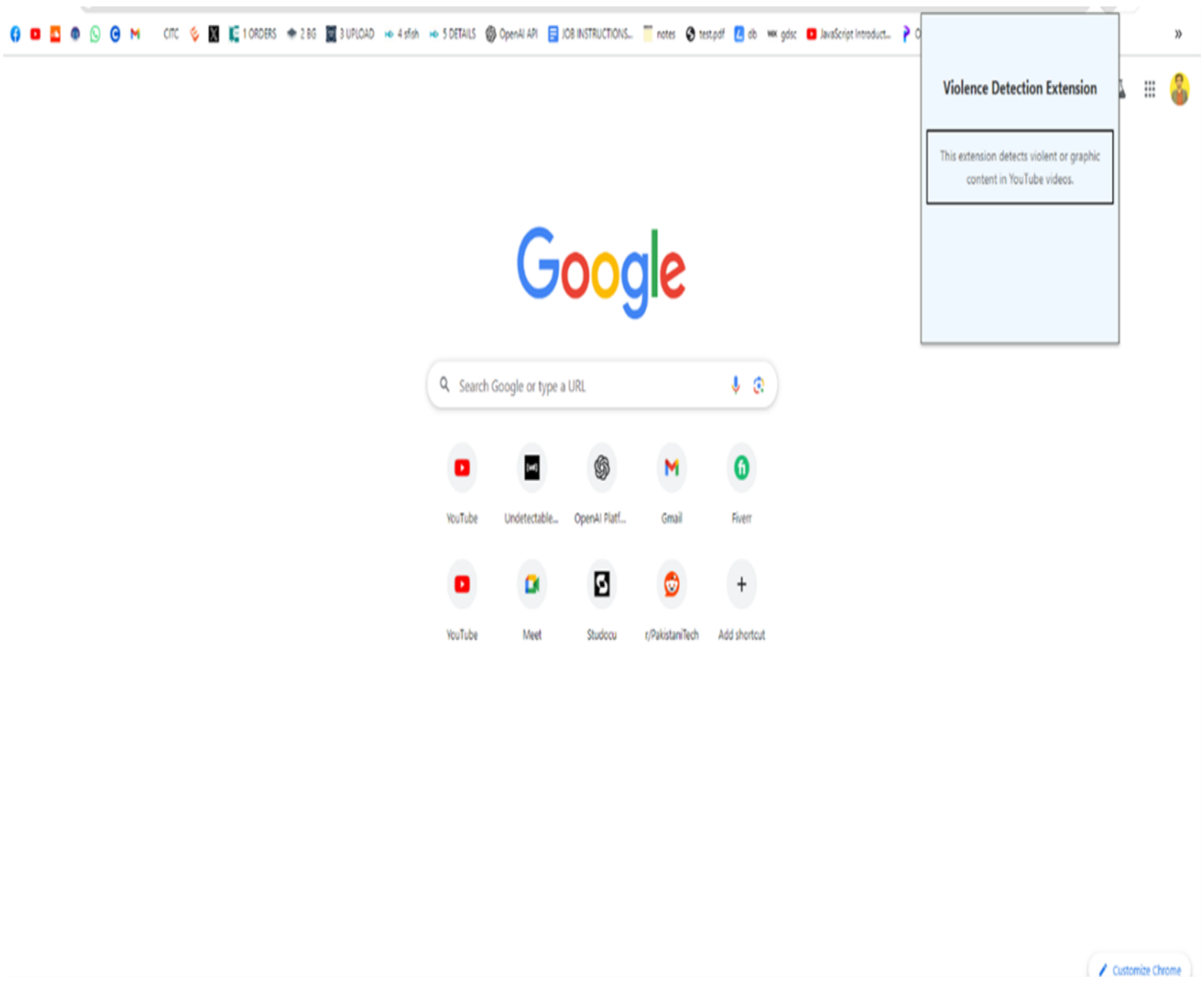

Violence Detection Extension
This extension detects violent or graphic content in YouTube videos.
Search Google or type a URL
YouTube
Undetectable...
OpenAI Platf...
Gmail
Fiverr
YouTube
Meet
Studocu
r/PakistaniTech
Add shortcut
Customize Chrome

Fig 5.3 Browser Extension Dashboard

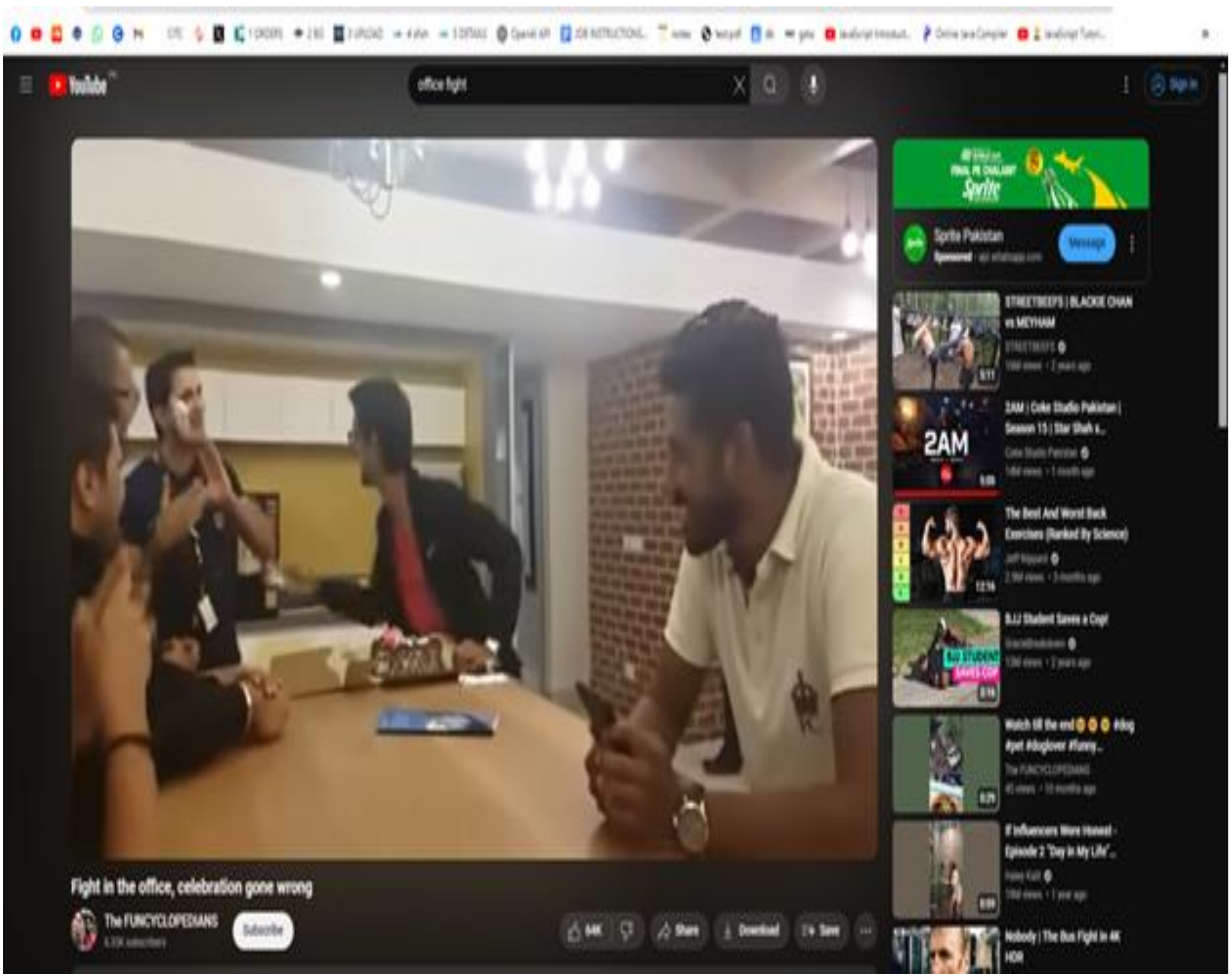
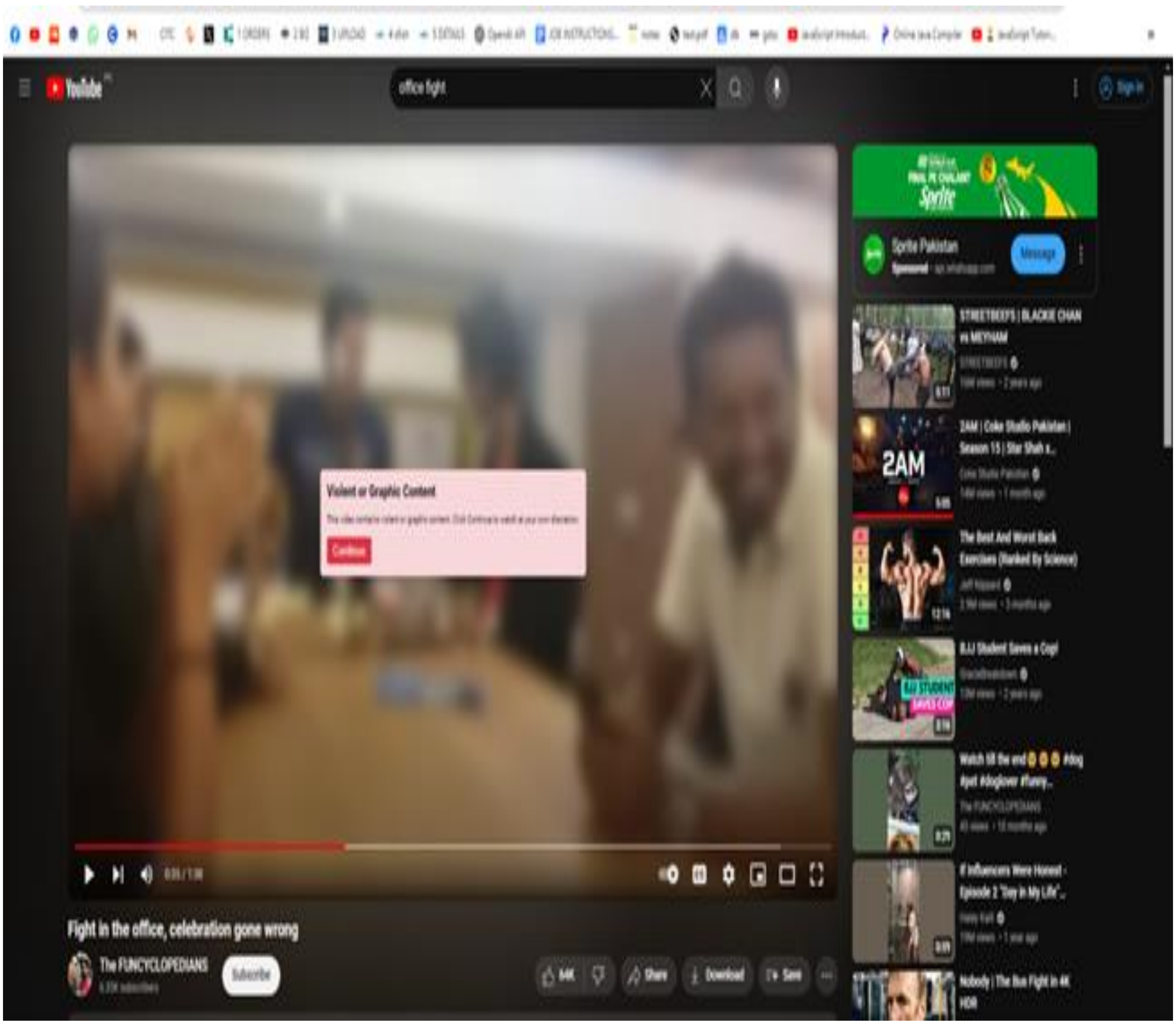

office fight
Fight in the office, celebration gone wrong
The FUNCYCLOPEDIANS
Subscribe
Share
Download
Save
STREETBEEFS | BLACKIE CHAN vs MEYHAM
2AM | Coke Studio Pakistan | Season 15 | Star Shah x...
The Best And Worst Back Exercises (Ranked By Science)
BJJ Student Saves a Cop!
If Influencers Were Honest - Episode 2 "Day in My Life"...
Nobody | The Bus Fight in 4K HDR

Fig 5.4 Browser Playing


YouTube
office fight
Sign in
Sprite Pakistan
Message
STREETBEEFS | BLACKIE CHAN vs MEYHAM
2AM | Coke Studio Pakistan | Season 15 | Star Shah x...
The Best And Worst Back Exercises (Ranked By Science)
BJJ Student Saves a Cop!
If Influencers Were Honest - Episode 2 "Day In My Life"...
Nobody | The Bus Fight in 4K HDR
Share
Download
Save
Subscribe
The FUNCYCLOPEDIANS

Violent or Graphic Content

This video contains violent or graphic content. Click Continue to watch at your own discretion.

Continue

Fight in the office, celebration gone wrong

Fig 5.4 Violence Detection

6. Testing and Evaluation

6.1. Manual Testing

6.1.1. Unit Testing

Test each individual module of the system.

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Table 6.1: Violence Detection Test case

No	**Test case**	**Inputs**	**Expected result**	**Test case result**
1	Video Frames Extraction	Sensor Trigger: Video frames	Video splited in different frames	Pass
2	Video frames segmentation	Video Analysis using each frame	Video Moving through lapse	Pass
3	Play Youtube video via link	Paste link in the browser	Videos plays and model runs it	Pass
4	Play YouTube Video in any Browser	Turn extension on any video in any browser	It would run in any browser	Pass
		Test fight and non-fight	Should detect and delay	

5	Test Normal Video	videos	warning	Pass

Table 6.2: Django Integration Test case

No	Test case description	Inputs	Expected result	Test case result
1	Run Temporal Context	Object within 85 cm range	Sensor accurately detects the object	Pass
2	Verify Extension integration	Varying environmental conditions	Sensor consistently triggers PRINTVIEW control	Pass
3	Test Response Time	Object movement speed	PRINTVIEW activates promptly	Pass

Table 6.3 User Working Test cases

no	Test case description	Inputs	Expected result	Test case result
1	Test Violent video	Play violence-based video	Video plays successfully	Pass
2	Test Nonviolent video	Play video containing nonviolent actions	Video plays successfully	Pass
3	Verify response time	Model responds to the video	Model responds on the violent video	Pass
4	Test cross browser integration	Install extension on other browsers	It would work	Pass
5	Test UI and UX Design	Turn on and off extension	Videovigil turned on	Pass

Table 6.4 Standby Mode extension Activation Test cases

No	**Test case description**	**Inputs**	**Expected result**	**Test case result**
1	Test Standby Mode Activation	Inactivity Period	extensions enter standby mode as expected	Pass
2	Verify extension Optimization	Varying Power Levels	extension optimizes power consumption	Pass

7. Conclusion and Future Work

7.1. Conclusion

The VideoVigil project addresses a pressing issue: the exposure to violent content online. We have developed an innovative web browser extension designed to detect violence in real-time as you watch videos. This powerful tool utilizes advanced deep learning techniques, including Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), to deliver exceptional accuracy. Furthermore, VideoVigil incorporates YOLO v8, a cutting-edge human detection system, enhancing its analytical precision. Our multifaceted approach allows VideoVigil to identify violent scenes with remarkable accuracy. However, the extension does more than just detect violence; it empowers you, the user. By providing timely warnings, VideoVigil enables you to make informed decisions about your viewing experience, thereby protecting both your safety and mental well-being.The development of VideoVigil was guided by a user-centric philosophy. We adopted the Agile methodology, promoting iterative development and continuous improvement. This approach ensured that we effectively tackled challenges such as computational expense, which could potentially affect user experience, and addressed biases within the training data.To ensure reliability and optimal performance, VideoVigil underwent comprehensive testing. This rigorous process included unit testing to evaluate individual components, functional testing to assess core functionalities, integration testing to ensure seamless interaction between components, and automated testing to guarantee consistent performance.

A key aspect of VideoVigil is its commitment to user privacy. Unlike some extensions, VideoVigil prioritizes data security by conducting video analysis locally on your device. This means that your videos are never uploaded to the cloud, ensuring compliance with relevant data protection regulations and giving you full control over your information. With VideoVigil, you can browse with confidence, knowing you have a reliable guardian against online violence. This extension empowers you to create a safer and more positive online video experience. VideoVigil's unique blend of advanced technology, user-centric design, and stringent privacy measures makes it an indispensable tool for today's internet users. Our commitment to excellence in the development of VideoVigil reflects our dedication to providing a safer online environment. The use of CNNs and RNNs, along with the integration of YOLO v8, ensures that the detection of violent content is both accurate and efficient. These technologies work together to analyze and interpret video content in real-time, delivering results that are both fast and reliable. Moreover, the Agile methodology has allowed us to remain flexible and responsive to user feedback. This iterative approach has enabled us to continually refine and improve VideoVigil, ensuring that it meets the evolving needs of our users. By addressing potential biases in the training data, we have worked to create a system that is fair and impartial, further enhancing the reliability of our extension.

Comprehensive testing has been crucial in the development of VideoVigil. Our rigorous testing protocols have ensured that every component functions correctly and that the extension delivers a seamless user experience. Automated testing has played a vital role in maintaining consistent performance, allowing us to quickly identify and address any issues that may arise.

In conclusion, VideoVigil represents a significant advancement in the fight against online violence. By leveraging advanced deep learning techniques and prioritizing user privacy, we have created an extension that not only detects violent content with exceptional accuracy but also empowers users to make informed decisions about their viewing experiences. With VideoVigil, you can enjoy a safer, more positive online environment, free from the threat of violent content.

7.2. Future Work

Moving forward, the VideoVigil project aims to further enhance its capabilities and address emerging challenges in violence detection and content moderation. Key areas for future development include continuous model training, utilizing larger and more diverse datasets to improve the accuracy and robustness of violence detection, especially in detecting evolving patterns of violent content. The project will also expand its content detection scope to include additional sensitive content such as hate speech, cyberbullying, and explicit material, thereby offering comprehensive protection to users. Another focus will be user feedback integration, implementing a robust feedback mechanism to allow users to report false positives and negatives, which will inform ongoing improvements to the detection algorithms. Ensuring cross-platform compatibility across various web browsers and operating systems will enhance accessibility and usability for a broader user base. Additionally, developing a real-time analytics dashboard will provide users with insights into flagged content and the effectiveness of the detection mechanism. Enhanced privacy features will be incorporated by using advanced privacy-preserving techniques such as federated learning to protect user data while optimizing model performance. The project will also establish a community engagement platform for collaboration among researchers, developers, and users to share insights, datasets, and innovations in violence detection technology. By focusing on these areas, the VideoVigil project aims to stay at the forefront of enhancing online safety and fostering responsible internet usage, ultimately contributing to a safer and more secure online environment for all users.

Moving forward, the VideoVigil project is dedicated to enhancing its capabilities and addressing new challenges in violence detection and content moderation. One primary area of focus is continuous model training. By utilizing larger and more diverse datasets, VideoVigil aims to improve the accuracy and robustness of its violence detection algorithms, especially in identifying evolving patterns of violent content. Expanding the scope of content detection is another key objective. VideoVigil plans to include additional sensitive content such as hate speech, cyberbullying, and explicit material in its detection repertoire, offering comprehensive protection to users against various forms of harmful content. This broader focus will ensure that users are safeguarded from a wide range of online threats. User feedback integration will play a crucial role in the ongoing improvement of VideoVigil. Implementing a robust feedback mechanism will allow users to report false positives and negatives, directly informing the refinement of the detection algorithms. This user-driven approach will ensure that VideoVigil remains accurate and reliable over time. To enhance accessibility and usability, the project aims to ensure cross-platform compatibility across various web browsers and operating systems. This will allow a broader user base to benefit from VideoVigil's protection. Additionally, the development of a real-time analytics dashboard will provide users with valuable insights into flagged content and the overall effectiveness of the detection mechanism. Privacy remains a top priority for

VideoVigil. The incorporation of advanced privacy-preserving techniques, such as federated learning, will protect user data while optimizing model performance. This approach ensures that user privacy is maintained without compromising the effectiveness of the violence detection system. Furthermore, VideoVigil will establish a community engagement platform to foster collaboration among researchers, developers, and users. This platform will facilitate the sharing of insights, datasets, and innovations in violence detection technology, driving the continuous improvement and evolution of the project. By focusing on these key areas, the VideoVigil project aims to stay at the forefront of enhancing online safety and fostering responsible internet usage. Ultimately, these efforts will contribute to a safer and more secure online environment for all users, ensuring that VideoVigil remains a trusted tool in the fight against online violence and harmful content.

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