



# REQUIREMENTS REPORT

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## AEGIS SHIELD - PHISHING DETECTION EXTENSION

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## 1.0 INTRODUCTION

The **Aegis Shield - Phishing Detection Extension** is a browser extension designed to protect users from phishing and malware threats by providing real-time detection and proactive alerts. This report serves as a comprehensive account of how the project satisfies all specified functional and non-functional requirements, ensuring that the extension delivers a secure, efficient, and user-friendly experience.

The document categorizes the requirements into **Must-Have**, **Should-Have**, **Could-Have**, and **Won't-Have** using the MoSCoW framework, providing a detailed analysis of their implementation status. For each requirement, the report highlights the design, development, and integration processes, along with unimplemented aspects where applicable. It also emphasizes the alignment of the extension with industry standards, including compliance with **Chrome Web Store policies** and adherence to **Secure Data Handling** practices.

By documenting the implemented and planned features, this report not only demonstrates the project's success in meeting its objectives but also lays the foundation for future enhancements to further improve its capabilities and user protection.

## 2.0 REQUIREMENTS SUMMARY

The following table outlines all the requirements identified for the **Aegis Shield - Phishing Detection Extension** as detailed in the project proposal. These requirements are categorized based on priority using the MoSCoW framework (Must-Have, Should-Have, Could-Have, and Won't-Have). They include both functional and non-functional requirements, ensuring the project meets its objectives of real-time phishing detection, user-friendly features, and compliance with industry standards.

Features and enhancements with potential for future development are primarily listed under the **Should-Have** and **Could-Have** sections. Items in the **Won't-Have** section include features that were deprioritized for this phase but were considered for implementation if time and resources permitted.

Priority	Requirement Type	Requirement	Description
Must-Have	Functional	Real-Time URL Monitoring	Monitor all visited URLs in the browser and analyze them for phishing or malware indicators using VirusTotal API.
		Phishing URL Detection	Detects and flag suspicious or malicious URLs based on API analysis results.
		Basic User Alerts	Provide real-time notifications or pop-ups when malicious URLs are detected, with actionable options like "Block" or "Proceed with caution."
		Whitelist/Blacklist Management	Allow users to add trusted websites (whitelist) and blocked websites (blacklist).
		Basic Malware Detection	Use VirusTotal API to analyze URLs for potential malware threats.
		Email Phishing Detection	Allow users to paste email content or headers for analysis and detect phishing indicators in embedded links or sender details
		Browser Notifications	Send categorized browser notifications with severity levels, such as safe, suspicious or malicious.
	Non-Functional	Lightweight and Efficient Design	The extension must have a lightweight design to ensure minimal impact on browser performance
		User-Friendly Interface	Provide an intuitive interface that is accessible to non-technical users.
		Compliance with Chrome Policies	Adhere to Chrome Web Store policies for extension development and security.

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		Secure Data Handling	Ensure user data is handled securely, complying with data protection standards.
Should-Have	Functional	Severity-Based Alerts	Provide additional context in alerts, such as the threat level and recommended actions for users.
		Email Content Parsing	Automatically parse and analyze structured email content for embedded phishing links.
Could-Have	Functional	Advanced Machine Learning for Phishing Detection	Integrate pre-trained models to identify phishing patterns and implement basic machine learning models for improved detection accuracy.
		Heuristic URL Analysis	Add support for detecting suspicious patterns in URLs, such as typosquatting, IP-based URLs, and uncommon TLDs.
		Customizable User Settings	Enable users to adjust detection sensitivity (e.g., strict vs. moderate modes) and toggle features like malware scanning or heuristic analysis.
Won't-Have	Functional	Multi-Browser Compatibility	Extend the extension to support browsers like Firefox, Edge, and Brave.
		Sandbox Integration for File Analysis	Add a feature to upload and scan files for malware using APIs like VirusTotal.

*Table 1: Proposed Project Scope*

## 3.0 REQUIREMENT IMPLEMENTATION DETAILS

This section provides a detailed breakdown of how each requirement identified in the project was addressed during implementation. It covers the design, development, and integration of both functional and non-functional requirements, along with their current implementation status. For partially implemented or unimplemented features, the section outlines their planned functionality and the steps needed for future completion. Each requirement is analyzed to highlight its contribution to the overall objectives of the Aegis Shield - Phishing Detection Extension.

### 3.1 MUST-HAVE FUNCTIONAL REQUIREMENTS

The Must-Have Functional Requirements are the core features of the Aegis Shield - Phishing Detection Extension that were prioritized for implementation to ensure the project meets its primary objectives. These include real-time URL monitoring, phishing detection, malware detection, and user alerts, among others. Each feature is designed to provide a robust and secure browsing experience, enabling users to identify and mitigate phishing and malware threats effectively. This section details the implementation and integration of these essential functionalities, confirming their completion and operational status.

#### 3.1.1 REQUIREMENT: REAL-TIME URL MONITORING

The Real-Time URL Monitoring feature is a critical component of the Aegis Shield - Phishing Detection Extension. This functionality is designed to provide continuous and automated protection against phishing threats while users browse the internet. It works by monitoring all URLs visited in the browser and analyzing them for potential phishing or malware indicators using the VirusTotal API, which aggregates results from multiple security vendors to provide comprehensive threat intelligence. By leveraging VirusTotal, the feature enhances detection accuracy and reliability. Users are immediately alerted to potential risks, enhancing their browsing safety and minimizing exposure to malicious content.

##### 3.1.1.1 IMPLEMENTATION

The implementation of **Real-Time URL Monitoring** ensures that users are continuously protected by analyzing all visited URLs for potential phishing or malware threats, providing immediate feedback on their safety status.

#### URL Monitoring Using Chrome Extension APIs

- We used the *chrome.tabs.onUpdated* listener to detect and track URL changes in browser tabs. This ensures that all navigations, including direct URL inputs, are monitored in real-time.
- The *chrome.webNavigation.onBeforeNavigate* and *onCompleted* events were utilized to capture redirected URLs. This guarantees that any intermediate redirections are also analyzed.



## URL Threat Analysis Using VirusTotal API

- URLs extracted during browsing were sent to VirusTotal's API for threat analysis. This API scans URLs against multiple security databases and provides a detailed report on whether a URL is safe, suspicious, or malicious.
- A secure API key was retrieved from the backend server to prevent exposing it in the extension's frontend code. The backend, built using Flask, handled API key distribution and access management.
- The API's response was parsed to extract critical details such as the number of security vendors flagging the URL and the overall threat categorization.

## Threat Categorization and Alerts

- Based on VirusTotal's analysis, URLs were categorized into:
  - **Safe:** No security vendors flagged the URL.
  - **Suspicious:** A small number of vendors flagged the URL as potentially harmful.
  - **Malicious:** A significant number of vendors marked the URL as dangerous.
- Real-time alerts were implemented using browser notifications to inform users of the threat status. Alerts were customized to indicate the severity level (e.g., safe, suspicious, or malicious) and provide actionable options, such as blocking or proceeding with caution.

## Caching for Improved Performance

- A caching mechanism was implemented using *chrome.storage.local* to store recently scanned URLs along with their threat analysis results and timestamps. This reduced redundant API calls and improved performance.
- Cached results were set to expire after a predefined time (e.g., 1 hour). This ensured that URLs were periodically re-checked for updated threat intelligence.

## Error Handling

- Graceful error handling mechanisms were implemented to manage API timeouts, rate limits, or invalid responses. In such cases, fallback notifications were shown to users indicating the inability to analyze a URL.

## Security and Performance Optimization

- All communication with VirusTotal was secured using HTTPS. API keys were securely managed and not exposed in the client-side code.
- The extension was designed to run lightweight processes, ensuring minimal impact on browser performance and resource usage.

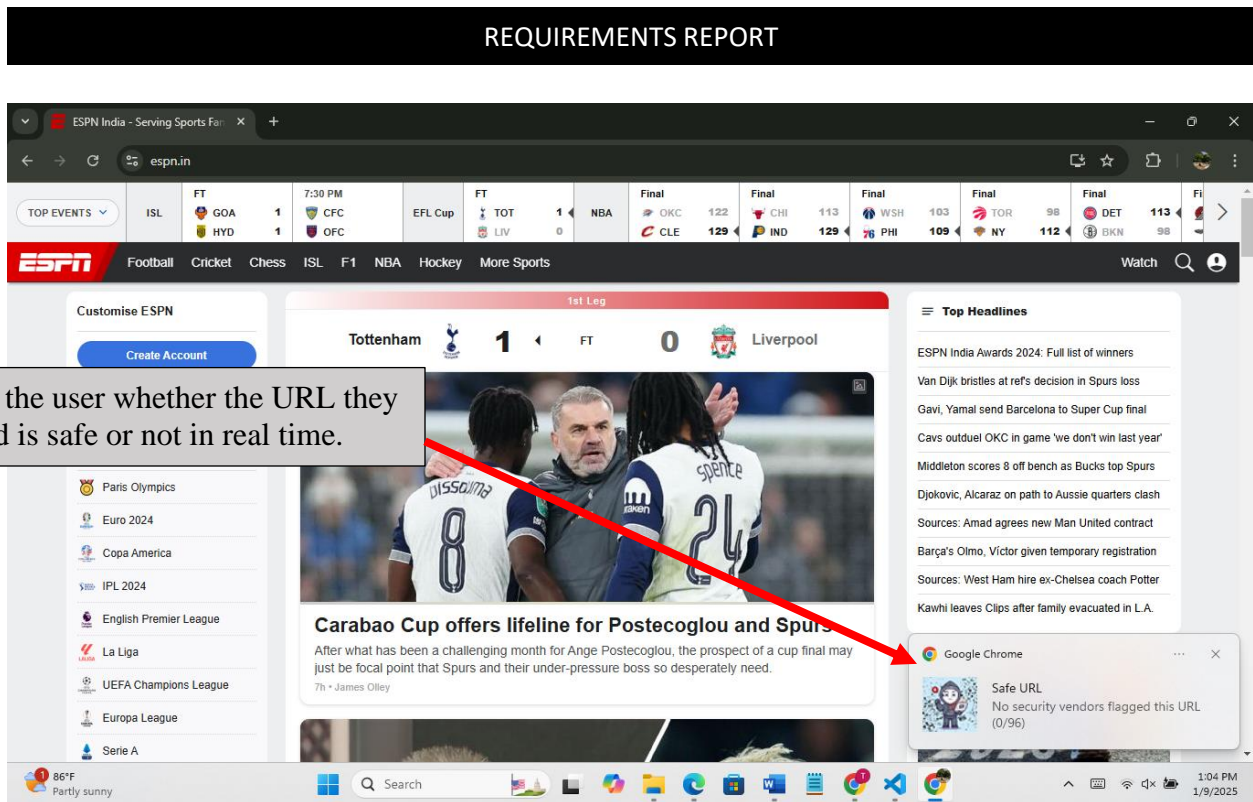


Figure 1: Output 1- Real-Time URL Monitoring

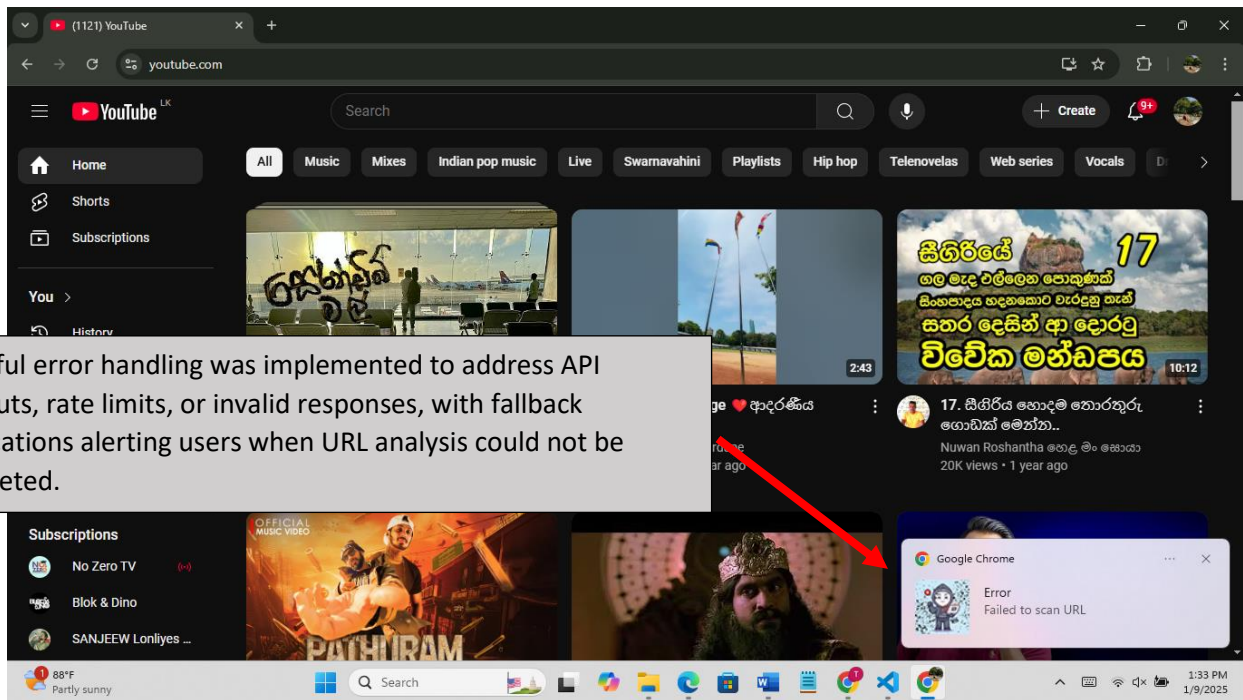


Figure 2: Output 2- Real-Time URL Monitoring

Requirement status: **100% implemented**

### 3.1.2 REQUIREMENT: PHISHING URL DETECTION

The Phishing URL Detection feature enables users to manually paste a URL into the extension's interface to check whether it is malicious or safe. This functionality provides an additional layer of control and flexibility, allowing users to verify URLs they encounter outside regular browsing activities (e.g., from emails, documents, or chat messages). Additionally, users can scan the URL of the currently active browser tab by clicking the Scan Current Tab button, streamlining the process of checking the safety of their ongoing browsing activity.

The feature integrates with the VirusTotal API to analyze the provided or active URL against a database of known phishing and malicious websites. It categorizes URLs as safe, suspicious, or malicious based on the API's analysis results, giving users immediate feedback on the safety of the URL.

#### 3.1.2.1 IMPLEMENTATION

The implementation of Phishing URL Detection allows users to seamlessly analyze both manually entered URLs and the current active tab, ensuring comprehensive protection against potential phishing threats.

##### User Input Interface

- A dedicated input field was added to the extension's popup interface, allowing users to paste URLs for analysis.
- "Scan current tab" field was added to the interface, allowing users to scan the current tab by one click
- A "Scan URL" button was provided alongside the input field to trigger the analysis process. This ensures the user has full control over when the URL is analyzed.

##### URL Validation and Processing

- Valid URLs are sent to the VirusTotal API for analysis. The URL is securely transmitted to the API endpoint, ensuring data integrity and privacy.

##### Threat Analysis Using VirusTotal API

- The VirusTotal API was integrated into the extension's backend system. The API scans the submitted URL against multiple security databases and returns a detailed analysis.
- The API response includes critical details, such as the number of security vendors that flagged the URL and their specific findings.

##### Real-Time Results Display

- The extension displays the analysis results directly in the popup interface.

## Notifications and Alerts

- For high-risk URLs (Malicious), a browser notification is triggered to emphasize the threat, even if the user closes the popup interface.
- Alerts within the popup are styled to indicate severity (e.g., green for Safe, yellow for Suspicious, red for Malicious).

## Error Handling

- Graceful error handling was implemented to address scenarios like API downtime, rate limits, or invalid API responses.
- If the analysis fails, users are shown a fallback message, such as "ERROR: API request failed: Scan request failed."

## Security and Privacy

- All interactions with the VirusTotal API are secured via HTTPS to ensure data confidentiality.
- URLs submitted by users are not stored locally or transmitted elsewhere, ensuring privacy and compliance with data protection standards.

## Optimization and Performance

- The analysis process was designed to run asynchronously to prevent delays or interruptions in the user interface.
- Errors are handled in real-time, and the interface immediately notifies users if the analysis cannot proceed.

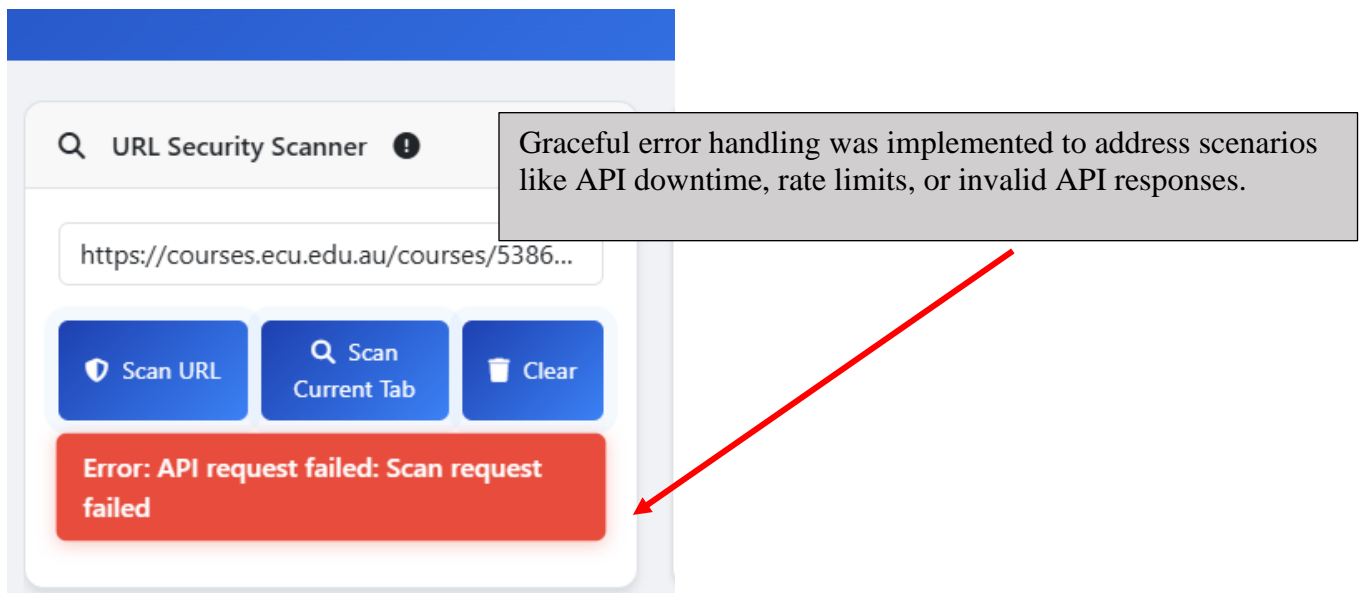


Figure 3: Output 1-Phishing URL Detection

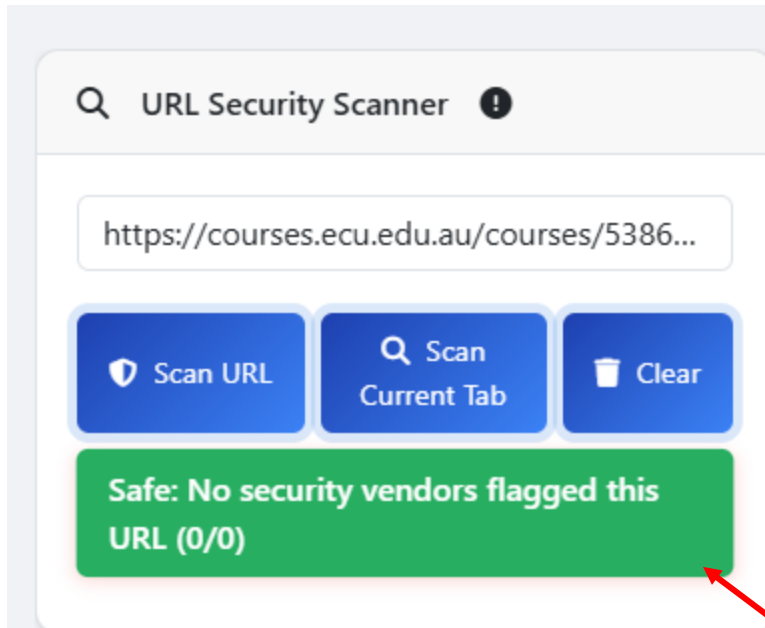


Figure 4: Output 2-Phishing URL Detection

The extension displays the analysis results directly in the popup interface.

Requirement status: **100% implemented**

## 3.1.3 REQUIREMENT: BASIC USER ALERTS

The Basic User Alerts feature is a user-facing functionality of the Aegis Shield - Phishing Detection Extension that ensures users are promptly informed of any potential threats detected during their browsing sessions. This feature delivers real-time notifications or pop-ups when a URL is identified as suspicious or malicious, enabling users to take immediate action to protect themselves.

### 3.1.3.1 IMPLEMENTATION

The implementation of Basic User Alerts ensures users receive real-time notifications about potential threats, allowing them to take immediate action to protect their browsing experience.

#### Integration with Real-Time Threat Detection

- The Basic User Alerts feature is directly integrated with the Real-Time URL Monitoring and Phishing URL Detection functionalities.
- Whenever a URL is analyzed and categorized (safe, suspicious, or malicious), the alert system is triggered based on the threat level.

#### Notifications and Privacy

- When a user browses a malicious URL or encounters harmful content, the extension's popup will immediately display a real-time warning, alerting the user to the potential threat.
- All notifications are generated locally within the browser to prevent sensitive information (e.g., URLs) from being transmitted externally.
- The system ensures that no user data or browsing history is stored or transmitted outside the extension, maintaining user privacy.

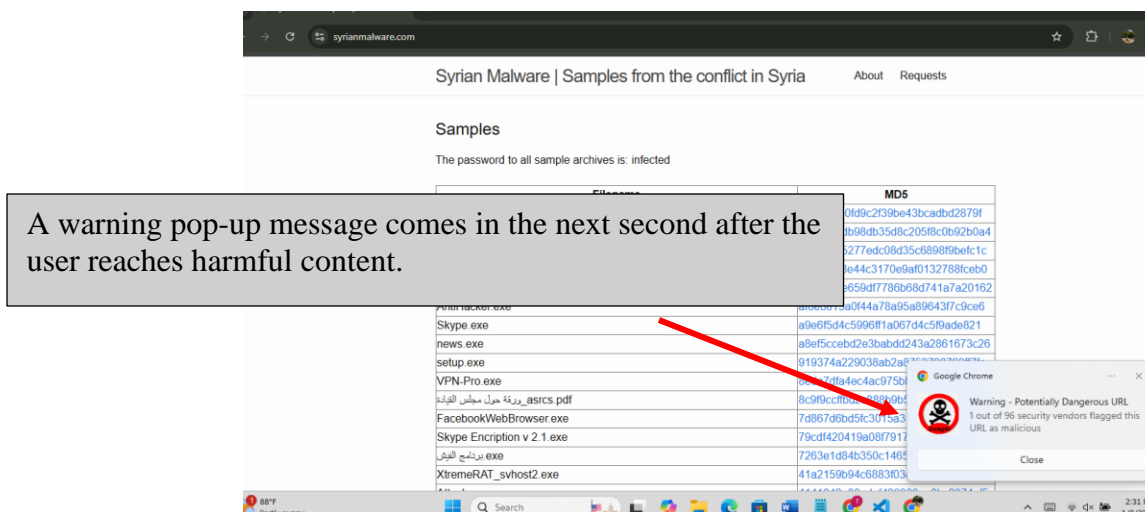


Figure 5: Output 1-Basic User Alerts

Requirement status: **100% implemented**

### 3.1.4 REQUIREMENT: WHITELIST/BLACKLIST MANAGEMENT

The Whitelist/Blacklist Management feature is a critical component of the URL Management functionality within the extension's user interface. It enables users to define custom rules for handling specific URLs by maintaining two separate lists:

#### 1. Whitelist:

- A collection of trusted URLs that are considered safe by the user.
- When a user visits a whitelisted URL, the extension's popup notifies the user that the URL is in the whitelist and marked as safe. The URL bypasses further analysis to ensure a smooth browsing experience.

#### 2. Blacklist:

- A collection of URLs identified by the user as harmful or undesirable.
- When a user visits a blacklisted URL, the extension displays a warning popup, alerting the user about the associated risks and recommending blocking the page or navigating away.

#### 3.1.4.1 IMPLEMENTATION

The implementation of Whitelist/Blacklist Management provides users with the flexibility to customize URL handling by maintaining trusted and blocked lists, enhancing both security and convenience.

#### URL Management Interface

- Added a dedicated **URL Management** section in the extension's popup interface with fields to manage whitelist and blacklist entries.
- This section includes:
  - An input field for users to add URLs.
  - Buttons to add URLs to the whitelist or blacklist.
  - Two separate lists displaying currently added URLs for both whitelist and blacklist.
  - Remove buttons next to each listed URL for easy deletion.

#### Adding URLs to Whitelist or Blacklist

- URLs added to the whitelist or blacklist are stored locally using *chrome.storage.local*, ensuring persistence across browser sessions.
- When the popup is opened, the stored lists are retrieved and displayed in the interface.

## Real-Time Application of Whitelist/Blacklist Rules

- When a user visits a whitelisted URL, the system bypasses real-time analysis and alerts.
- Instead, a popup notification confirms that the URL is in the whitelist and considered safe.
- When a user visits a blacklisted URL, the extension uses Chrome's *declarativeNetRequest* API to block navigation automatically.
- A warning popup is displayed, alerting the user about the blocked URL and its associated risks.

## Removal of URLs

- Users can remove URLs from either the whitelist or blacklist directly from the popup interface.
- The removal process dynamically updates the stored lists and reflects changes immediately in the UI.

## Notifications for Whitelist and Blacklist

- Displayed when a whitelisted URL is visited, confirming the URL is trusted and bypassed from analysis.
- Triggered when a blacklisted URL is accessed, alerting the user with a warning and providing appropriate options.

## Security and Performance

- Ensured that whitelist and blacklist entries are stored securely without exposure to external systems.
- Designed the feature to run efficiently without significant performance impact on the browser or the extension.

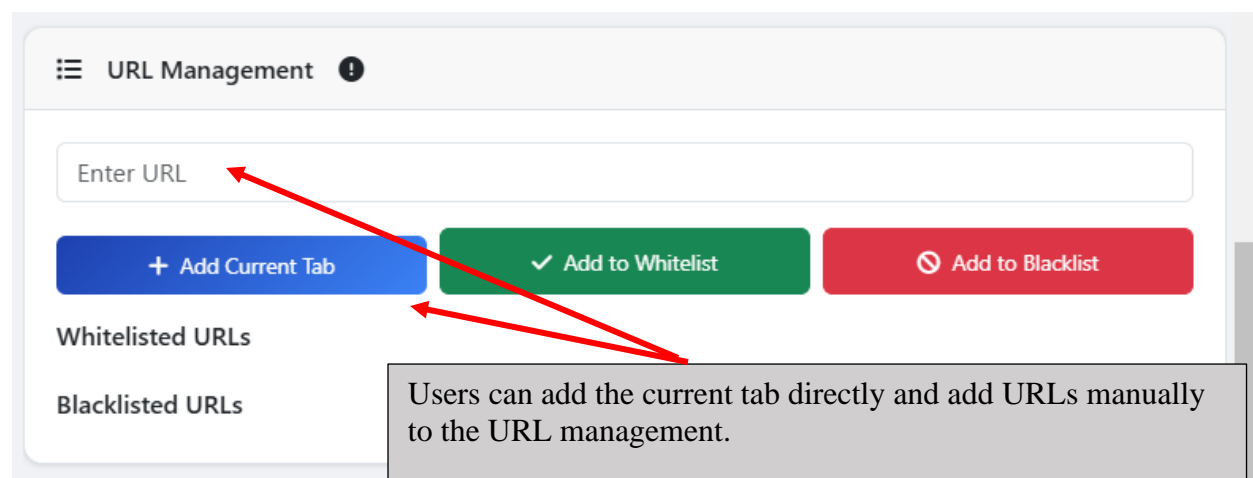


Figure 6: Output 1: Whitelist/Blacklist Management



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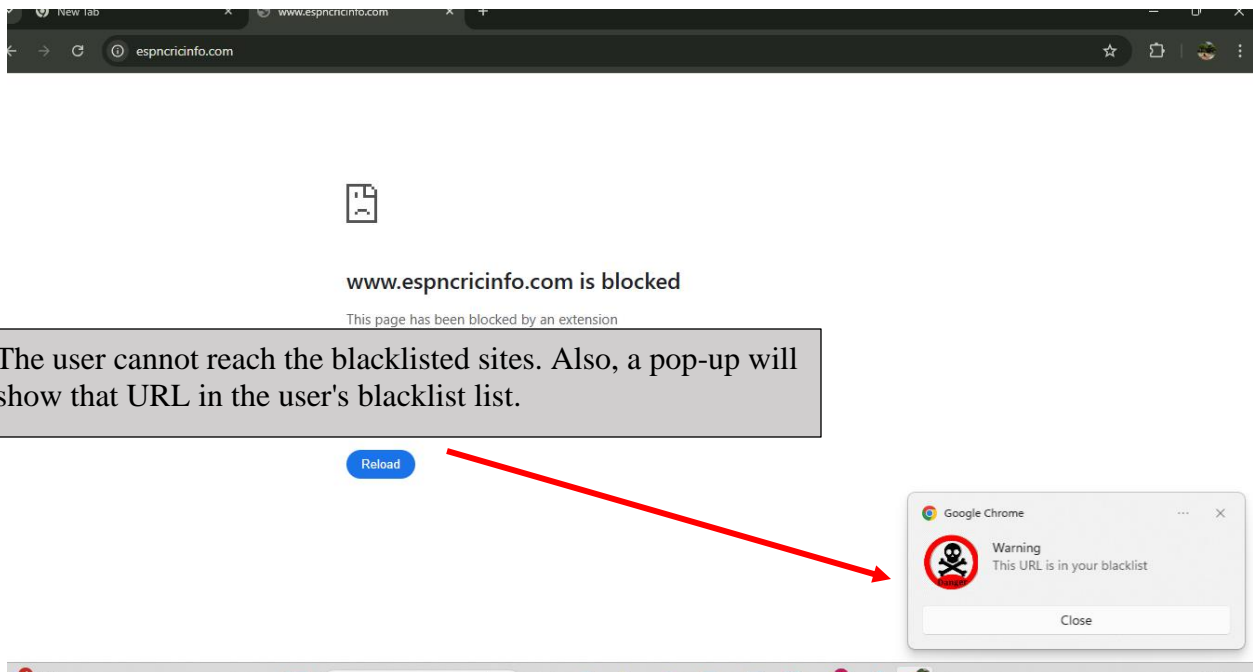


Figure 7: Output 2: Whitelist/Blacklist Management

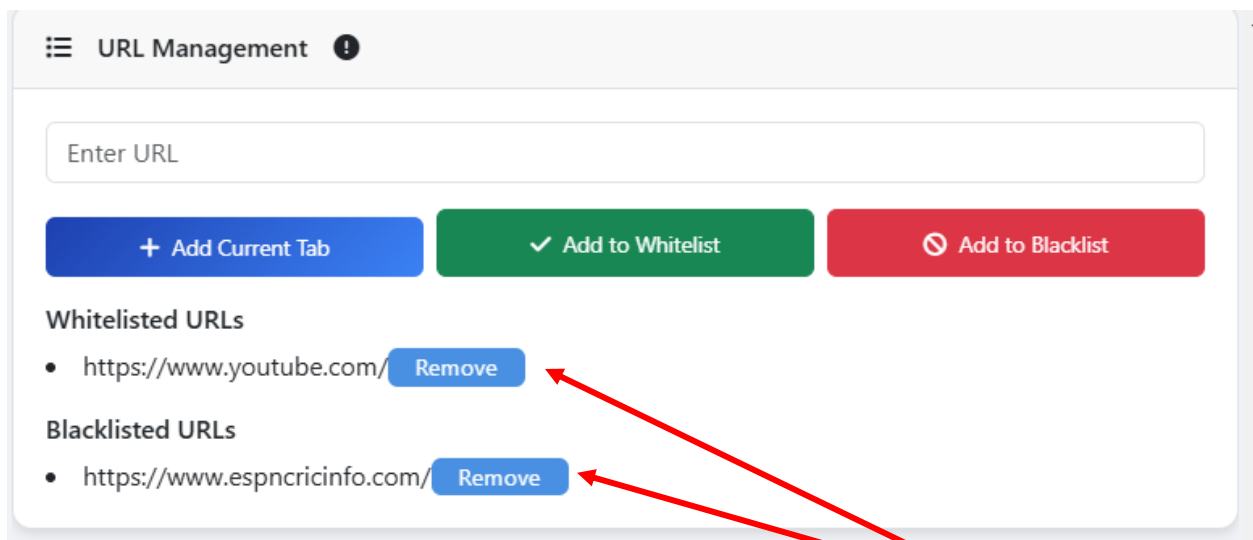


Figure 8: Output 3: Whitelist/Blacklist Management

Users can remove URLs from either the whitelist or blacklist directly

Requirement status: **100% implemented**

## 3.1.5 REQUIREMENT: BASIC MALWARE DETECTION

The Basic Malware Detection feature allows users to paste a URL into the extension's interface to check for potential malware threats. This feature integrates with the VirusTotal API, leveraging its capabilities to analyze URLs against a comprehensive database of known malware signatures and security threats. Users can quickly verify whether a URL is safe, suspicious, or malicious, helping to mitigate the risk of interacting with harmful content.

This functionality is crucial for providing an additional layer of protection, enabling users to analyze URLs they encounter in various contexts, such as email links, downloads, or websites, ensuring a secure browsing experience.

### 3.1.5.1 IMPLEMENTATION

The implementation of basic malware detection enables users to analyze urls for potential malware threats using the virustotal api, ensuring a safer browsing experience.

#### URL Input Interface

- A dedicated section in the extension's popup interface allows users to paste a URL for analysis.
- Upon entering a URL, the interface validates the input format and displays a confirmation message if the URL is ready for analysis.
- If no URL is provided or the input is invalid, a user-friendly prompt requests a valid URL.

#### Threat Analysis with VirusTotal API

- The URL is securely transmitted to the VirusTotal API for analysis.
- The API scans the URL against multiple security databases and returns a detailed report.
- The API response includes critical details, such as the number of security vendors flagging the URL and specific threat indicators.

#### Real-Time Notifications

- For URLs flagged as suspicious or malicious, a notification alerts the user to the potential threat.
- Notifications include a summary of the results and a link to detailed information on VirusTotal.

#### Error Handling

- If the VirusTotal API is unavailable or the request fails, fallback notifications inform the user of the issue and suggest retrying later.

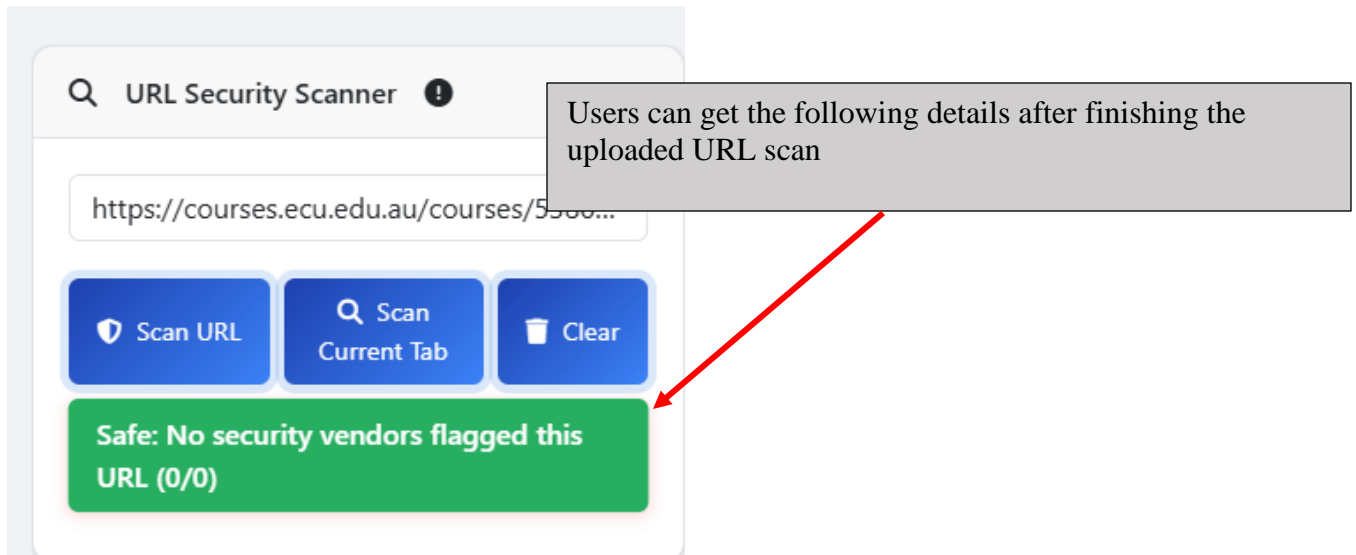


Figure 9: Output 1-Basic Malware Detection

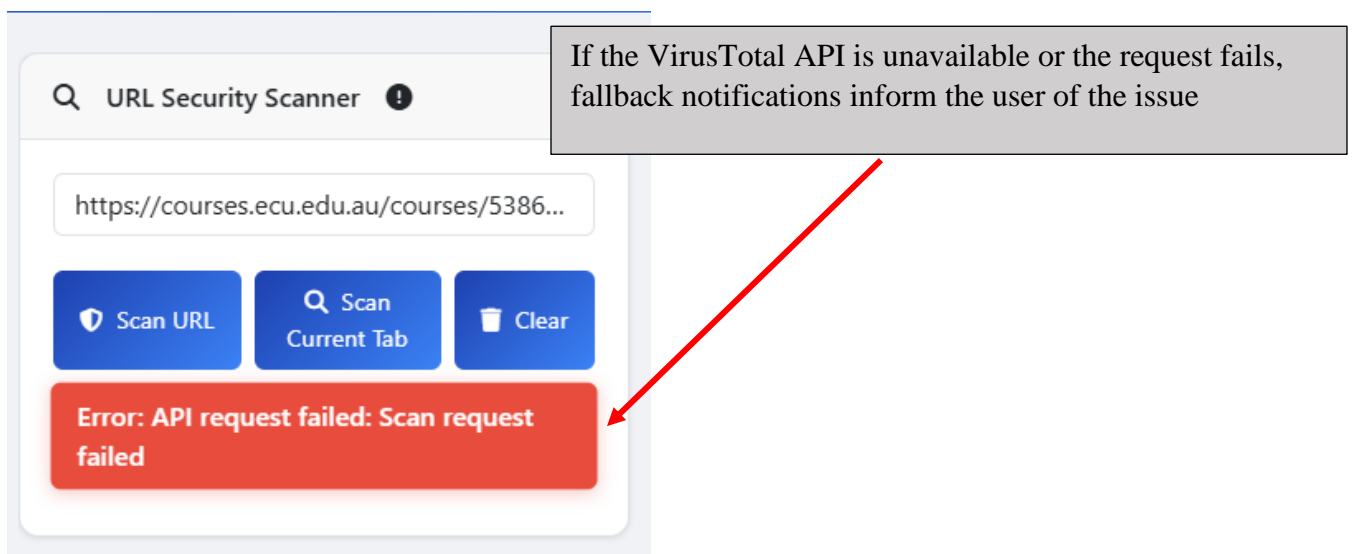


Figure 10: Output 2-Basic Malware Detection

Requirement status: **100% implemented**

### 3.1.6 Requirement: Email Phishing Detection

The Email Phishing Detection feature allows users to paste email content or headers into the extension for analysis, leveraging trained Machine Learning (ML) models to identify potential phishing threats. Unlike other features, this functionality does not interact with external services like VirusTotal. Instead, it focuses on detecting phishing indicators by analyzing keywords (e.g., "urgent," "verify your account"), patterns (e.g., generic greetings, typos), embedded links (e.g., suspicious domains, uncommon TLDs), and sender details (e.g., mismatched domains). The ML models evaluate these features to classify the email as Safe, Suspicious, **or** Malicious. This real-time analysis enhances user security by empowering them to identify and avoid phishing attempts effectively.

#### 3.1.6.1 IMPLEMENTATION

The implementation of Email Phishing Detection empowers users to analyze email content or headers using trained machine learning models, providing insights into potential phishing threats.

##### Email Input Interface

- A dedicated section in the extension's popup interface allows users to paste email content or headers for analysis. Includes:
  - A large text box for users to input email content or headers.
  - An "Analyze Email" button to initiate phishing detection.
- The system checks if the pasted content is non-empty and formatted appropriately. Invalid or empty inputs prompt users to re-enter valid data.

##### Preprocessing and Feature Extraction

- Extracts structured data such as links, sender details, and email text for further analysis.
- Key features are derived from the email content, including:
  - **Keywords:** Identifies suspicious terms like "urgent," "reset password," or "click here."
  - **Patterns:** Detects generic greetings (e.g., "Dear User"), misspellings, or unusual formatting.
  - **Links and URLs:** Extracts embedded links and evaluates their structure for signs of phishing (e.g., typosquatting, uncommon TLDs).
  - **Sender Details:** Extracts and evaluates sender domains for anomalies, such as spoofed domains or mismatched names and addresses.

##### Analysis Using Machine Learning Models

- Integrates pre-trained ML models trained on datasets of phishing and legitimate emails.
- Models evaluate features such as keywords, sender patterns, and links to classify the email.

- The ML model outputs a probability score for phishing likelihood, categorizing the email into:
  - **Safe:** No significant signs of phishing.
  - **Suspicious:** Some indicators of phishing.
  - **Malicious:** Strong evidence of phishing.

### Displaying Analysis Results

- Results are displayed in the extension's popup interface, categorized into Safe, Suspicious, or Malicious.
- Includes visual indicators such as green for safe, yellow for suspicious, and red for malicious emails.



### Security and Privacy

- All analysis is performed locally in the browser, ensuring user privacy by preventing email content from being transmitted externally.
- The system does not store or log email content, maintaining compliance with privacy standards.

### Performance Optimization

- The ML models are optimized for quick predictions to ensure a seamless user experience.
- Feature extraction and analysis processes are streamlined to minimize resource usage while maintaining high accuracy.

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 ML-Powered Email Content Detector 

Paste email content here



Analyze Email

Clear

Please enter email content

Invalid or empty inputs prompt users to re-enter valid data.

Figure 11: Output 1-Email Phishing Detection

 ML-Powered Email Content Detector 

education by rail 2023

Where will you go after a university, Sudam? With an education from Miami, the answer is wherever you want!

Analyze Email

Clear

Safe Email

Output After Analyzing

Figure 12: Output 2-Email Phishing Detection

Requirement status: **100% implemented**

### 3.1.7 REQUIREMENT: BROWSER NOTIFICATIONS

The Browser Notifications feature enhances the user experience by providing real-time alerts about the safety of URLs, files, or email content being analyzed by the Aegis Shield - Phishing Detection Extension. These notifications categorize threats into different severity levels such as Safe, Suspicious, and Malicious

#### 3.1.7.1 IMPLEMENTATION

The implementation of Browser Notifications ensures users receive categorized real-time alerts about detected threats, enhancing awareness and enabling prompt action.

##### Integration with Threat Detection Systems

- Notifications are tightly integrated with other threat detection systems such as URL Monitoring, Phishing Detection, and File Analysis.
- Whenever a threat is detected during any of these processes, a notification is automatically triggered.
- The system categorizes threats into **Safe**, **Suspicious**, or **Malicious** based on analysis results.

##### Designing the Notification Content

- Notifications are designed to clearly communicate the severity level:
  - **Safe:** A reassuring message indicating no threats detected.
  - **Suspicious:** A warning advising users to proceed with caution.
  - **Malicious:** A critical alert recommending the user avoid interacting with the flagged content.

##### Visual Design

- Visual elements (e.g., icons or color codes) help users quickly identify the severity of the notification:
  - Green for safe.
  - Yellow for suspicious.
  - Red for malicious.
- Notifications are designed to be compact, ensuring they do not obstruct the user's browsing experience.

##### User Action Integration

- Notifications provide actionable buttons or links, such as:
  - Add to whitelist/blacklist.
  - View detailed analysis results in the popup interface.
- The system handles user actions (e.g., blocking a URL) immediately and updates the relevant lists or rules dynamically.

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### Error Handling

- Graceful error handling mechanisms were implemented to manage API timeouts, rate limits, or invalid responses. In such cases, fallback notifications were shown to users indicating the inability to analyze a URL.

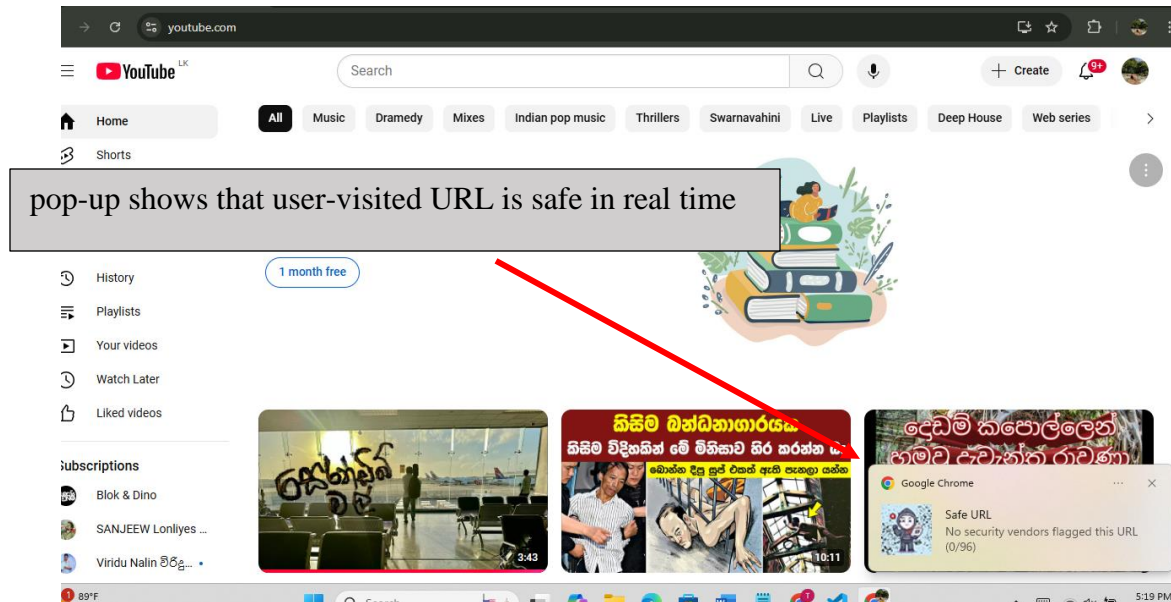


Figure 13: Output 1-Browser Notifications

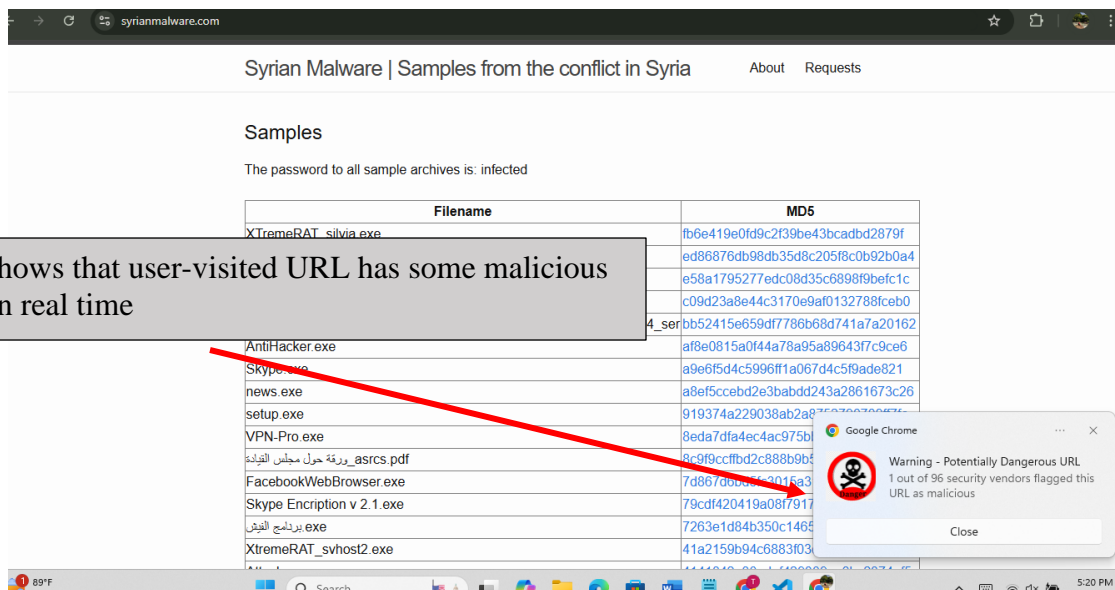


Figure 14: Output 2-Browser Notifications

Requirement status: **100% implemented**



### 3.2 SUMMARY OF MUST-HAVE FUNCTIONAL REQUIREMENTS

All **Must-Have Functional Requirements** outlined in the project have been successfully implemented, ensuring the extension meets its core objectives. Each feature, including **Real-Time URL Monitoring**, **Phishing URL Detection**, **Basic User Alerts**, **Whitelist/Blacklist Management**, **Basic Malware Detection**, **Email Phishing Detection**, and **Browser Notifications**, has been developed and tested to provide a seamless and secure user experience. This section summarizes the implementation status of these requirements, confirming they are 100% complete and operational.

Requirement	Requirement Status
Real-Time URL Monitoring	100% implemented
Phishing URL Detection	100% implemented
Basic User Alerts	100% implemented
Whitelist/Blacklist Management	100% implemented
Basic Malware Detection	100% implemented
Email Phishing Detection	100% implemented
Browser Notifications	100% implemented

Table 2: Summary of Must-Have Functional Requirements

### 3.3 MUST-HAVE NUN-FUNCTIONAL REQUIREMENTS

The Must-Have Non-Functional Requirements focus on ensuring that the extension operates efficiently, adheres to security and compliance standards, and provides a seamless user experience. These requirements include designing the extension to be lightweight, user-friendly, and secure while strictly adhering to Chrome Web Store policies. Each non-functional requirement supports the extension's core functionalities by improving performance, usability, and trustworthiness, ensuring it meets both technical and user expectations.

#### 3.3.1 REQUIREMENT: LIGHTWEIGHT AND EFFICIENT DESIGN

The Lightweight and Efficient Design requirement ensures that the Aegis Shield - Phishing Detection Extension **operates** seamlessly without significantly impacting browser performance. The extension is optimized to use minimal memory and CPU resources, enabling smooth operation even during intensive tasks like real-time URL monitoring, phishing detection, and file analysis. Asynchronous operations and caching mechanisms reduce redundant computations, while lightweight frameworks and libraries keep the extension's footprint small. Background processing handles resource-intensive tasks without disrupting the user experience, and the interface is designed for quick responsiveness and ease of use. Additionally, the extension is tested for compatibility across various Chrome versions, ensuring consistent performance on both modern and older systems. This approach balances advanced functionality with efficient resource usage, delivering a seamless and high-performing extension.

##### 3.3.1.1 IMPLEMENTATION

The implementation of Lightweight and Efficient Design ensures the extension operates smoothly with minimal impact on browser performance, leveraging optimized algorithms and caching mechanisms.

##### Optimized Resource Utilization

- Designed core functionalities, such as URL monitoring and phishing detection, to use minimal memory and CPU resources.
- Implemented lightweight algorithms and asynchronous processing for background tasks, reducing browser load.
- Frequently accessed data, like previously analyzed URLs, files, and email results, are cached locally using *chrome.storage.local*.
- Caching reduces redundant computations and API calls, significantly improving performance.

##### Streamlined Backend and Frontend

- Offloaded computationally intensive tasks, like file hashing or ML-based email analysis, to background scripts.
- Ensured that API interactions, including VirusTotal or ML model predictions, are performed asynchronously to avoid browser freezes.

- Used lightweight libraries and frameworks to reduce the extension's size and ensure quick interface loading.
- Designed a responsive and intuitive popup interface that reacts instantly to user interactions.

### **Background Processing**

- Moved resource-intensive operations to background scripts to ensure uninterrupted browsing for users.
- Tasks like URL scanning, file validation, and link extraction are managed independently from the main browser interface.
- Ensured non-blocking execution of tasks by using asynchronous and event-driven programming approaches.

### **Performance Testing and Optimization**

- Tested the extension's performance under various workloads, including high browsing activity and multiple simultaneous analyses.
- Monitored resource usage with Chrome Developer Tools to identify and optimize any bottlenecks.

### **Error Handling and Recovery**

- Implemented fallback mechanisms for scenarios where API calls fail or resources exceed thresholds, ensuring continued functionality without noticeable performance drops.

### **User Experience Enhancements**

- Designed the interface to load quickly and respond instantly to user inputs, even during high-load scenarios.
- Prioritized usability by minimizing wait times and ensuring seamless navigation within the popup.
- Ensured background processes operate silently, notifying users only, when necessary, to avoid disrupting their browsing experience.

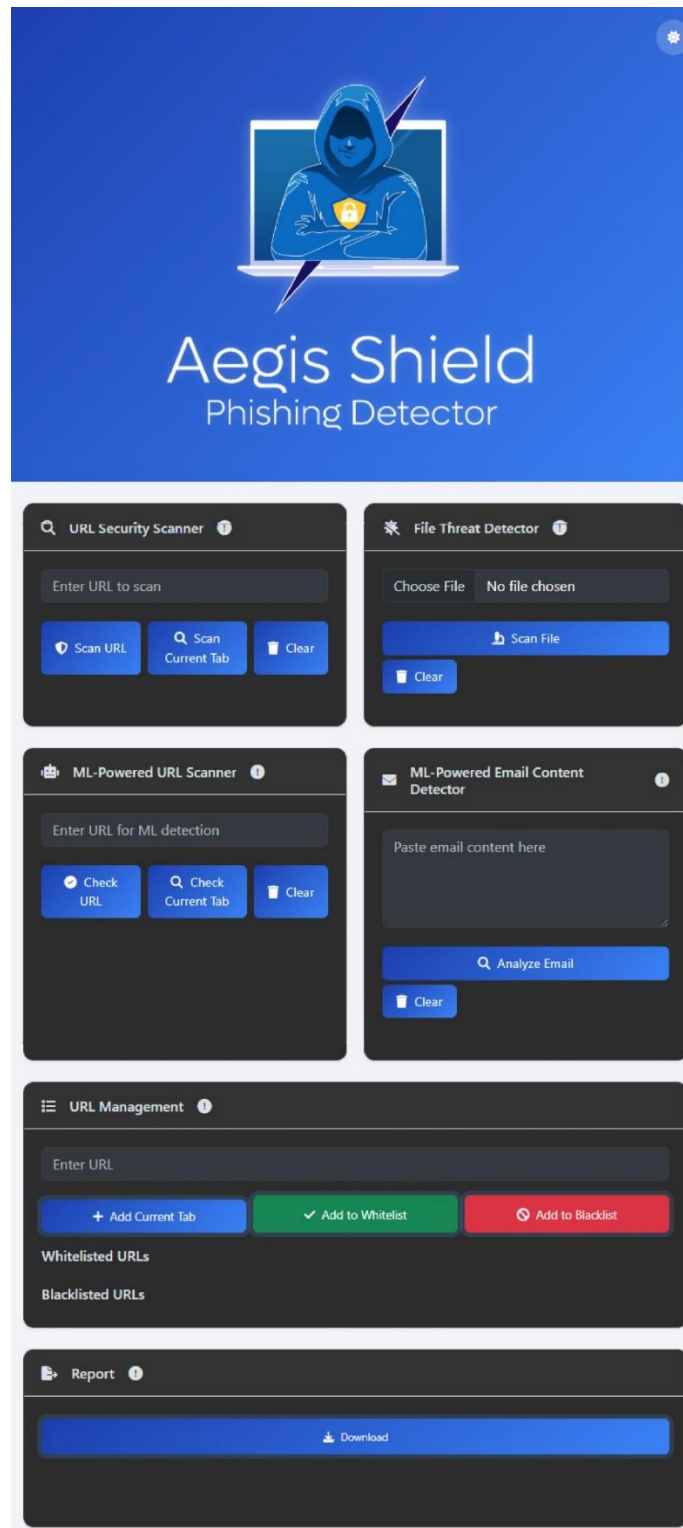


Figure 15: Output 1- Lightweight and Efficient Design

Requirement status: **100% implemented**

### 3.3.2 Requirement: User-Friendly Interface

The User-Friendly Interface requirement ensures that the Aegis Shield - Phishing Detection Extension is accessible, intuitive, and easy to use for all users, including non-technical individuals. Key features include a toggle for dark mode, allowing users to switch between light and dark themes for better visibility, and clear buttons for resetting inputs or removing data, ensuring a clutter-free experience. Tooltips are integrated into every feature, providing concise explanations to guide users, while the interface design prioritizes simplicity and logical organization for effortless navigation. Additionally, the responsive layout adapts to various screen sizes, and color-coded visual elements help users focus on essential features and notifications. This design ensures that users can efficiently interact with the extension and access its functionalities with ease.

#### 3.3.2.1 IMPLEMENTATION

The implementation of the User-Friendly Interface focuses on simplicity and accessibility, incorporating features like dark mode, tooltips, and responsive design to cater to users of all technical levels.

##### Dark Mode Integration

- A toggle button is added in the extension's popup interface, allowing users to switch between light and dark modes.
- User preferences for dark mode are stored using *chrome.storage.local* so that the setting persists across sessions.

##### Clear Buttons

- Clear buttons are integrated into sections such as URL management (whitelist/blacklist) and file or email analysis to allow users to reset inputs or remove previously added data.
- Clearing actions immediately update the displayed data, ensuring the interface reflects the changes in real time.

##### Accessibility for Non-Technical Users

- Feature names, tooltips, and notifications are written in straightforward, non-technical language to ensure they are easy to understand.
- Features are grouped by function (e.g., URL analysis, email phishing detection) and placed in an intuitive order within the interface to minimize confusion.
- Descriptive icons accompany buttons and features, providing visual cues for their purpose.
- Each button, input field, or feature includes a tooltip that appears on hover, providing a brief explanation of its functionality.
- Tooltips are designed to be non-intrusive, disappearing when not needed and adjusting their position based on screen size and element location.

## Responsive Design

- The interface uses a responsive grid system to adapt to various screen sizes and resolutions, ensuring usability on laptops, desktops, and larger monitors.
- Buttons, input fields, and text adjust dynamically to maintain readability and usability across different display settings.

## Visual Clarity

- The interface prioritizes essential features, reducing unnecessary elements to maintain focus and minimize distractions.
- Important actions and notifications are color-coded (e.g., green for success, red for warnings), helping users identify key information quickly.
- Uniform styling is applied across all elements to ensure a cohesive and professional look.

## Real-Time Updates

- Changes made in the interface (e.g., switching modes, clearing inputs) are reflected in real time, providing immediate feedback to users.
- Buttons and toggles are designed with smooth transitions and animations to create an engaging experience.

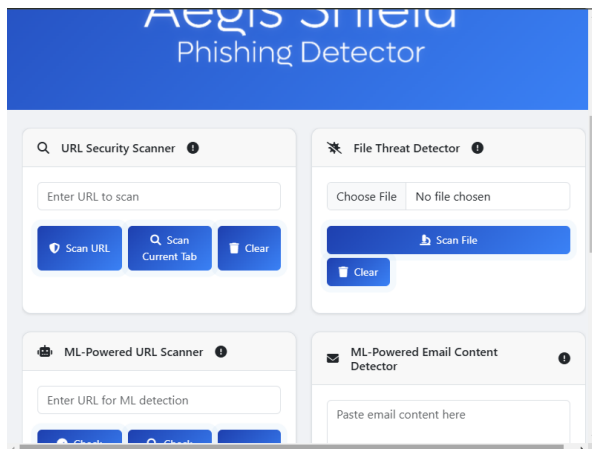


Figure 16: Output 1-User-Friendly Interface

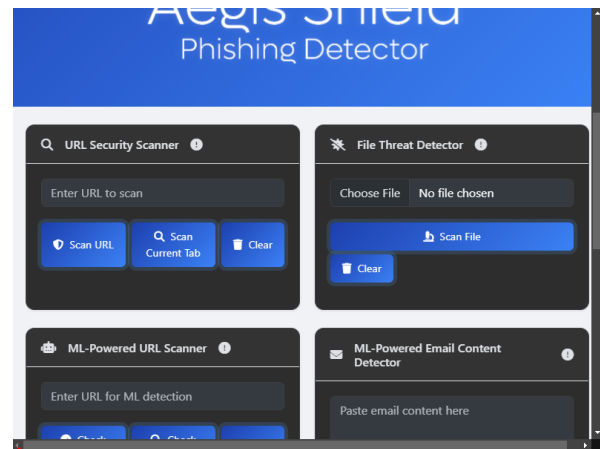


Figure 17: Output 2-User-Friendly Interface

Extension's popup interface, allowing users to switch between light and dark modes.

## REQUIREMENTS REPORT

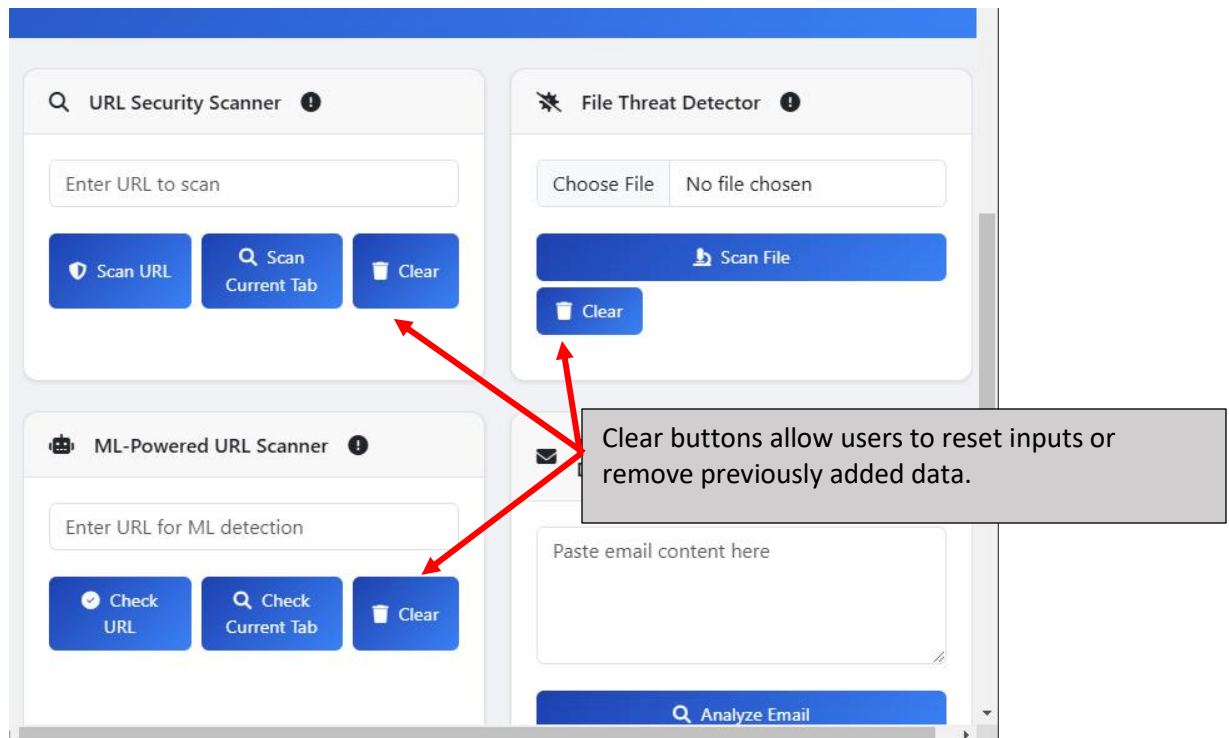


Figure 18: Output 3-User-Friendly Interface

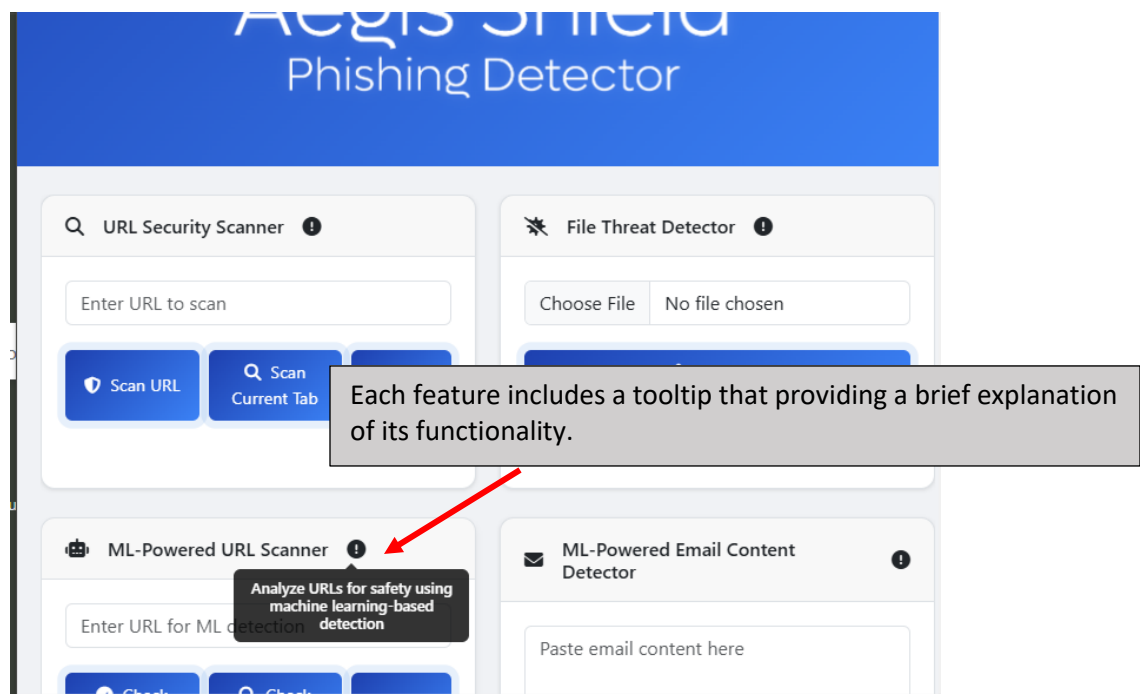


Figure 19: Output 4-User-Friendly Interface

Requirement status: **100% implemented**

### 3.3.3 REQUIREMENT: COMPLIANCE WITH CHROME POLICIES

The Compliance with Chrome Policies requirement ensures that the Aegis Shield - Phishing Detection Extension adheres to the guidelines and best practices set by the Chrome Web Store. These policies cover aspects such as user privacy, data security, and transparency to maintain a safe and trusted environment for users. The extension follows strict rules for data collection and handling, ensuring that no sensitive user data is stored or transmitted without explicit user consent. All permissions requested by the extension are clearly disclosed and limited to what is necessary for its functionality. Additionally, the extension complies with coding standards to prevent vulnerabilities and includes a clear and concise privacy policy to inform users about how their data is managed. These measures ensure the extension is secure, trustworthy, and eligible for publication and updates on the Chrome Web Store.

#### 3.3.3.1 IMPLEMENTATION

The implementation of Compliance with Chrome Policies ensures the extension adheres to Chrome Web Store guidelines, prioritizing user privacy, secure data handling, and transparent permission management.

#### Adherence to Privacy and Data Handling Policies

- The extension only collects data strictly necessary for its functionality, such as URLs for analysis. No unnecessary or sensitive user data is accessed or stored.
- A privacy policy is included in the Chrome Web Store listing and the extension's settings, detailing what data is collected, how it is used, and how user privacy is maintained.

#### Permission Management

- The extension requests only essential permissions, such as access to tabs and web navigation for URL monitoring or notifications for alerts.
- All requested permissions are explained in the Chrome Web Store listing to ensure user clarity and trust.
- Each permission is justified in the extension's documentation and complies with Chrome Web Store policies to avoid unnecessary or overly broad requests.

#### Secure Coding Practices

- The extension is developed using secure coding practices to prevent vulnerabilities such as cross-site scripting (XSS) or unauthorized access.
- Updates are released periodically to address security vulnerabilities and maintain compliance with evolving Chrome Web Store guidelines.
- Comprehensive error handling ensures that unexpected behaviors do not lead to security risks or data leaks.



### Compliance with Extension Guidelines

- The *manifest.json* file is configured according to the latest Chrome extension specifications, including correctly defining permissions, content scripts, and background scripts.
- The extension is reviewed against the latest Chrome Web Store policies to ensure it remains compliant with all requirements, including user experience and security guidelines.

**Requirement status:** **100% implemented**

### 3.3.4 REQUIREMENT: SECURE DATA HANDLING

The Secure Data Handling requirement ensures that all user data processed by the Aegis Shield - Phishing Detection Extension is managed with the highest standards of security and privacy. This involves implementing robust measures to protect data from unauthorized access, breaches, or misuse. The extension processes only essential data, such as URLs or email content, and does so locally whenever possible to minimize exposure. Any external communication, such as API requests to VirusTotal, is encrypted using secure HTTPS protocols. No sensitive user data is stored persistently, and all temporary data is cleared after processing. By adhering to established data protection standards and guidelines, this requirement ensures user trust and compliance with privacy regulations.

#### 3.3.4.1 IMPLEMENTATION

The implementation of Secure Data Handling focuses on protecting user data through minimized data collection, encrypted communication, and adherence to data protection standards.

##### Minimizing Data Collection

- The extension collects only the data required for its functionality, such as URLs, email content, or file hashes, without accessing or storing unnecessary user information.
- Data processed by the extension is stored temporarily and cleared immediately after processing to avoid prolonged exposure or misuse.

##### Secure Communication with External APIs

- Communication with external services, such as VirusTotal, is secured using HTTPS protocols to encrypt data during transmission.
- API keys are stored securely in the backend or using browser-specific secure storage mechanisms to prevent unauthorized access.

##### Data Anonymization

- When communicating with external APIs, only anonymized or non-sensitive data (e.g., file hashes instead of full files) is transmitted to maintain user privacy.
- The extension does not track user activity or behavior, ensuring complete privacy during browsing sessions.

Requirement status: **100% implemented**

### 3.4 SUMMARY OF MUST-HAVE NUN-FUNCTIONAL REQUIREMENTS

All **Must-Have Non-Functional Requirements** identified for the **Aegis Shield - Phishing Detection Extension** have been successfully implemented, ensuring the extension meets performance, usability, compliance, and security standards. Key features such as lightweight design, a user-friendly interface, strict adherence to Chrome Web Store policies, and robust data handling practices contribute to delivering a seamless and secure user experience. This section confirms that these requirements are 100% implemented, enhancing the extension's reliability and trustworthiness.

Requirement	Requirement Status
Lightweight and Efficient Design	100% implemented
User-Friendly Interface	100% implemented
Compliance with Chrome Policies	100% implemented
Secure Data Handling	100% implemented

*Table 3: Summary of Must-Have Nun-Functional Requirements*

## 3.5 SHOULD-HAVE FUNCTIONAL REQUIREMENTS

The Should-Have Functional Requirements are additional features that enhance the extension's functionality and user experience but were not prioritized for the initial phase. These include features like Severity-Based Alerts **and** Email Content Parsing, which provide advanced threat analysis and improved usability. While some progress was made in implementing these features, others remain as potential enhancements for future iterations, showcasing the extension's scalability and commitment to evolving security needs.

### 3.5.1 REQUIREMENT: SEVERITY-BASED ALERTS

The Severity-Based Alerts feature provides enhanced notifications by offering detailed context about detected threats, enabling users to better understand and respond to potential risks. This feature categorizes threats into distinct levels of severity, including Low, Moderate, and High, based on the results of analyzing URLs, files, or email content. Alerts are designed to include actionable recommendations tailored to the specific threat level. For low-severity threats, users are informed that no immediate action is needed. For moderate threats, the alert advises users to proceed with caution, such as double-checking links or sender details. For high-severity threats, the alert strongly recommends actions like blocking access, avoiding further interaction, and reporting the issue as a security concern. These detailed alerts empower users to make informed decisions, ensuring effective protection against phishing, malware, and other security risks.

#### 3.5.1.1 IMPLEMENTATION

The implementation of **Severity-Based Alerts** introduces categorized threat notifications, providing users with real-time context about the severity of detected risks.

#### Monitoring Real-Time User Activities

- The Severity-Based Alerts feature is integrated with existing real-time monitoring systems, such as URL Monitoring, File Scanning, and Email Analysis.
- Alerts are triggered automatically.
- Alerts are displayed in the browser notification system and in the extension popup.
- Each alert includes the severity level (e.g., Low, Moderate, or High) and a brief description of the threat (e.g., "This URL has been flagged by 5 vendors for potential phishing risks").

#### User Notifications

- Real-time alerts appear as browser notifications to immediately inform users of the detected threat and its severity.
- The extension popup provides a centralized view of recent alerts, categorized by severity for easier navigation.

## REQUIREMENTS REPORT

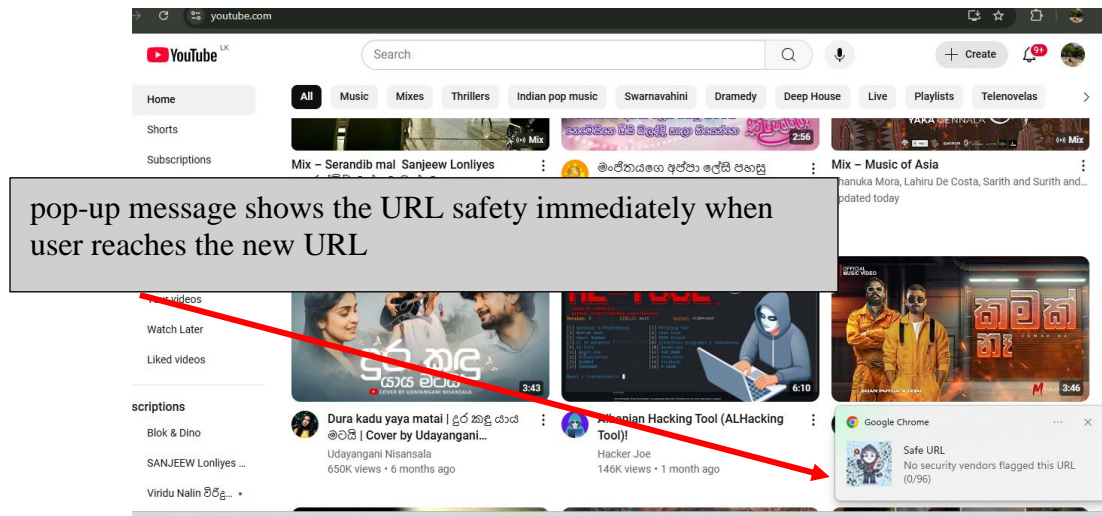


Figure 20: Output 1-Severity-Based Alerts

### 3.5.1.2 UNIMPLEMENTED ASPECTS

The unimplemented aspects of **Severity-Based Alerts** include providing actionable recommendations and interactive options tailored to the detected threat level.

#### Recommended Actions for Users

- Although severity levels are displayed in alerts, specific recommended actions for users based on the threat level (e.g., "Proceed with caution," "Block access") were not implemented.
- Features such as interactive options within alerts (e.g., "Block URL," "Add to Whitelist") and step-by-step guidance on handling threats are currently not included.
- Alerts do not provide advice on actions such as reporting phishing attempts, verifying sender details, or avoiding unsafe links.

Requirement status: **60% implemented**

### 3.5.2 REQUIREMENT: EMAIL CONTENT PARSING

The Email Content Parsing feature enables the extension to automatically analyze structured email content to identify embedded phishing links or suspicious elements. This functionality focuses on extracting and evaluating critical components of an email, such as links, sender details, and formatting, to detect potential threats without requiring manual user input. By automating the analysis process, this feature streamlines threat detection and provides users with proactive protection against phishing attempts. It parses the email content for hidden or shortened URLs, checks the legitimacy of sender details, and evaluates patterns commonly associated with phishing attacks, such as urgent language or generic greetings. This capability enhances the extension's ability to identify phishing threats efficiently and accurately.

#### 3.5.2.1 UNIMPLEMENTED ASPECTS

The Email Content Parsing feature has not been implemented in this phase of development. Below is an outline of the steps that would have been taken to achieve this functionality:

##### Automated Email Parsing

- The system does not automatically parse email content to extract structured elements like sender details, subject lines, or embedded links.

##### Automated Link Extraction

- No functionality exists to automatically identify and extract URLs hidden within email bodies or HTML tags.

##### Automated Threat Analysis

- The system does not evaluate extracted email components (e.g., links or sender details) for phishing or malware indicators without manual input.

##### Automated Categorization

- Emails are not automatically classified into Safe, Suspicious, or Malicious categories based on detected threats.

##### Automated User Alerts

- The system does not provide real-time notifications or warnings about potential threats identified within email content.

#### Automated Integration with Email Clients:

- No automated connections or integrations with email platforms (e.g., Gmail, Outlook) are implemented to fetch and analyze email content seamlessly.

Requirement status: **0% implemented**

### 3.6 SUMMARY OF SHOULD-HAVE FUNCTIONAL REQUIREMENTS

The **Should-Have Functional Requirements** represent features that add significant value to the extension but are not critical to its core functionality. While the **Severity-Based Alerts** feature has been partially implemented, focusing on real-time monitoring and severity categorization, it lacks detailed user recommendations. The **Email Content Parsing** feature has not been implemented in this phase but is identified as a potential area for future development. This section provides an overview of the current status of these requirements and highlights opportunities for further enhancement in subsequent iterations.

Requirement	Requirement Status
Severity-Based Alerts	<b>60% implemented</b>
Email Content Parsing	<b>0% implemented</b>

Table 4: Summary of Should-Have Functional Requirements

### 3.7 COULD-HAVE FUNCTIONAL REQUIREMENTS

The Could-Have Functional Requirements represent features that would further expand the extension's capabilities and provide advanced security functionalities. These include features like Advanced Machine Learning for Phishing Detection, Heuristic URL Analysis, and Customizable User Settings, which were identified as valuable enhancements but not prioritized for this phase. These features demonstrate the potential for future improvements to make the extension more intelligent, flexible, and user-focused.

#### 3.7.1 REQUIREMENT: ADVANCED MACHINE LEARNING FOR PHISHING DETECTION

The Advanced Machine Learning for Phishing Detection feature leverages trained machine learning models to predict whether a given URL is malicious or safe. This functionality enables users to paste a URL into the extension, which then analyzes the URL using an ML model trained on a dataset of phishing and legitimate URLs. The model evaluates various URL features, such as domain structure, URL length, use of special characters, and suspicious patterns, to predict the likelihood of the URL being malicious. By utilizing data-driven insights, this feature enhances the accuracy of threat detection and reduces reliance on external APIs. It represents a step forward in enabling sophisticated and independent phishing detection capabilities within the extension.

##### 3.7.1.1 IMPLEMENTATION

The implementation of Advanced Machine Learning for Phishing Detection enables the extension to analyze URLs using trained models, providing accurate predictions on whether a URL is malicious or safe.

##### Dataset Preparation and Training

- Gathered a comprehensive dataset of URLs, including both phishing and legitimate examples, from trusted sources like kaggle.
- Ensured the dataset was balanced to avoid bias in the model.
- Extracted key features from URLs to represent their characteristics numerically, such as:
  - Domain length.
  - Use of special characters.
  - Presence of IP addresses in URLs.
  - Use of uncommon top-level domains (TLDs).
  - Suspicious keywords often associated with phishing.
- Used machine learning algorithms such as Random Forest, Logistic Regression to train the model.
- Split the dataset into training and testing subsets to evaluate model performance.
- Tuned hyperparameters to optimize accuracy and reduce false positives/negatives.



## Integration with the Extension

- Added a dedicated input field in the extension's popup interface for users to paste URLs for analysis.
- A "Check URL" button allows users to initiate the ML-based prediction.
- When a URL is entered, the system preprocesses it to extract the same features used during model training.
- Ensured consistency between the features extracted during training and prediction phases.
- Ensured the model could run efficiently within the extension without significant performance overhead.

## Prediction and Results Display

- The processed URL features are fed into the ML model to generate a probability score for phishing likelihood.
- The result is classified as:
  - **Safe:** Low probability of phishing.
  - **Malicious:** High probability of phishing.

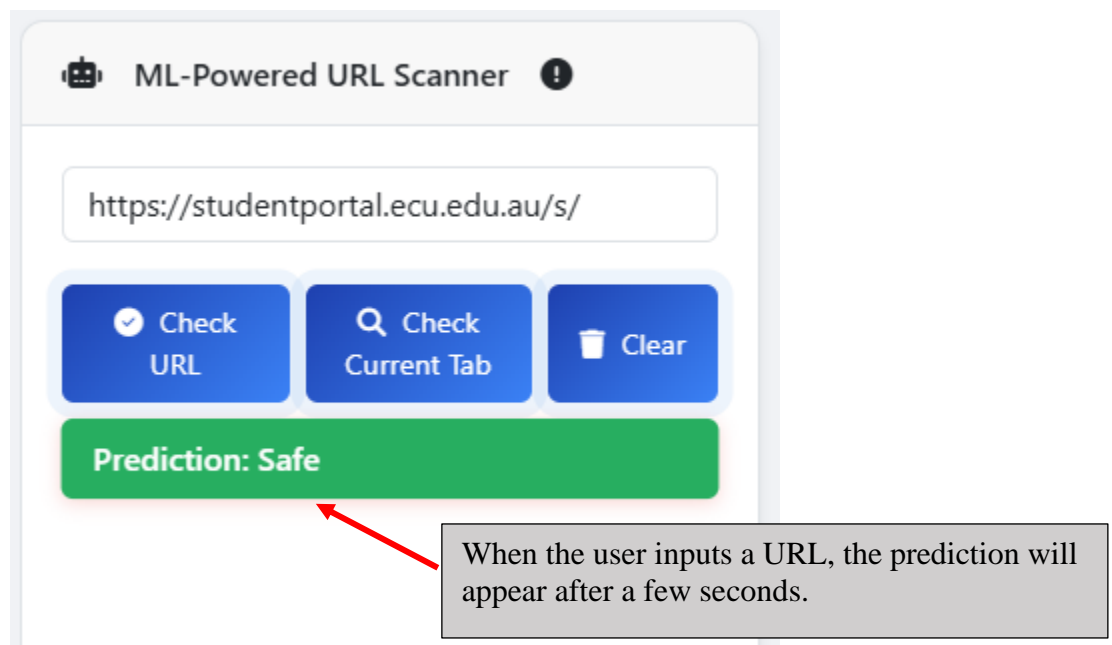


Figure 21:: Output 1-Advanced Machine Learning for Phishing Detection

Requirement status: **100% implemented**

### 3.7.2 REQUIREMENT: HEURISTIC URL ANALYSIS

The **Heuristic URL Analysis** feature aims to enhance the extension's phishing detection capabilities by identifying suspicious patterns in URLs that may indicate malicious intent. This feature analyzes URLs for common phishing tactics such as typosquatting (e.g., using misspelled domains like "gogle.com" instead of "google.com"), the presence of IP-based URLs (e.g., "http://192.168.1.1"), and the use of uncommon top-level domains (TLDs) that are often associated with phishing activities. By examining these characteristics, the system flags potentially harmful URLs and provides real-time alerts to users. This pattern-based approach complements other detection mechanisms, offering an additional layer of security against emerging phishing threats.

#### 3.7.2.1 UNIMPLEMENTED ASPECTS

The Heuristic URL Analysis feature has not been implemented in this phase of development. Below is an outline of the steps that would have been taken to achieve this functionality:

##### URL Pattern Detection

- Detect slight variations or misspellings in domain names (e.g., "goooogle.com" instead of "google.com").
- Implement algorithms to compare input URLs against known trusted domains and flag domains with high similarity scores.
- Identify URLs that use raw IP addresses instead of domain names, as these are often associated with malicious websites.
- Flag URLs with patterns such as "http://192.168.x.x" for further analysis.
- Maintain a database of trusted top-level domains (TLDs) and flag URLs using less common or suspicious TLDs (e.g., ".xyz", ".info", ".ru").

##### Feature Extraction

- Develop a parser to extract components of the URL, such as domain, subdomain, path, and query parameters.
- Analyze each component for signs of suspicious patterns.
- Define and implement heuristic rules to identify risky characteristics, such as overly long URLs, excessive use of special characters, or URL encoding.

##### User Alerts

- Provide real-time alerts to users for high-risk URLs, warning them of potential threats.

**Requirement status:** **0% implemented**

### 3.7.3 Requirement: Customizable User Settings

The Customizable User Settings feature enhances the user experience by allowing users to tailor the extension's functionality to their specific needs. This feature provides flexibility to adjust detection sensitivity levels, such as strict, moderate, or relaxed modes, enabling users to control the aggressiveness of phishing and malware detection. Additionally, it includes toggles to activate or deactivate specific features, such as malware scanning, heuristic URL analysis, or browser notifications, offering granular control over the extension's operations. These customization options ensure that both novice and advanced users can optimize the extension for their preferences and security requirements while maintaining a seamless and personalized browsing experience.

#### 3.7.3.1 UNIMPLEMENTED ASPECTS

The Customizable User Settings feature has not been implemented in this phase of development. Below is an outline of the steps required to implement this functionality:

##### Detection Sensitivity Adjustment

- Implement a dropdown or toggle in the extension's settings to allow users to select detection sensitivity modes:
  - **Strict:** Flags even minor risks to ensure maximum security.
  - **Moderate:** Balances security and usability, flagging only significant threats.
  - **Relaxed:** Focuses on critical threats, minimizing interruptions.
- Adjust the thresholds for flagging URLs, files, or emails based on the selected sensitivity level.
- Allow advanced users to define custom thresholds for various features, such as the number of flags required to categorize a URL as malicious.

##### Feature Toggles

- Provide toggles for users to activate or deactivate specific functionalities, such as:
  - **Real-Time URL Monitoring**
  - **Malware Scanning**
  - **Heuristic URL Analysis**
  - **Browser Notifications**
- Reflect changes immediately in the extension's behavior without requiring a restart.

##### User Interface Design

- Design a dedicated settings panel in the extension's popup or a separate page.
- Organize options into logical categories for ease of navigation, such as **Security Settings**, **Notifications**, and **Advanced Options**.

**Requirement status:** 0% implemented

### 3.8 SUMMARY OF COULD-HAVE FUNCTIONAL REQUIREMENTS

The **Could-Have Functional Requirements** represent features that would further enhance the extension's capabilities but were not prioritized for this phase of development. While the **Advanced Machine Learning for Phishing Detection** feature has been successfully implemented, features such as **Heuristic URL Analysis** and **Customizable User Settings** remain unimplemented but are identified as potential future enhancements. These requirements showcase opportunities to expand the extension's functionality, providing users with greater flexibility and advanced threat detection capabilities in subsequent iterations.

Requirement	Requirement Status
Advanced Machine Learning for Phishing Detection	100% implemented
Heuristic URL Analysis	0% implemented
Customizable User Settings	0% implemented

Table 5: Summary of Could-Have Functional Requirements

### 3.9 WON'T-HAVE FUNCTIONAL REQUIREMENTS

The Won't-Have Functional Requirements represent features that were deprioritized for this phase of development due to time constraints. Despite being initially categorized as out of scope, some progress was made. Multi-Browser Compatibility was successfully implemented for Edge and Brave browsers, while Firefox support remains unaddressed. Similarly, Sandbox Integration for File Analysis was fully implemented, demonstrating the team's commitment to delivering valuable functionalities where feasible, even for deprioritized features.

#### 3.9.1 REQUIREMENT: MULTI-BROWSER COMPATIBILITY

The Multi-Browser Compatibility requirement focuses on extending the functionality of the Aegis Shield - Phishing Detection Extension beyond Google Chrome to support other popular browsers like Firefox, Microsoft Edge, and Brave. This feature aims to ensure cross-browser compatibility, enabling a wider range of users to access and benefit from the extension's phishing detection capabilities. Achieving this would involve adapting the codebase to meet the specific requirements of each browser's extension ecosystem, such as different APIs or manifest formats. Multi-browser support would significantly expand the extension's user base and improve accessibility across various platforms, enhancing its reach and impact.

##### 3.9.1.1 IMPLEMENTATION

The implementation of Multi-Browser Compatibility ensures the extension works seamlessly on Chromium-based browsers like Edge and Brave, expanding its accessibility and usability.

##### Compatibility with Edge and Brave Browsers

- Since Edge and Brave browsers are based on the Chromium engine, the extension works seamlessly on these platforms with minimal or no changes to the codebase.
- The same manifest.json and Chrome Extension APIs used for Chrome are compatible with Edge and Brave.
- The extension was tested on these browsers to confirm functionality, including URL monitoring, phishing detection, and notifications.

##### 3.9.1.2 UNIMPLEMENTED ASPECTS

The unimplemented aspects of Multi-Browser Compatibility include adapting the extension for Firefox, requiring modifications to APIs and additional testing for full functionality.

- The extension is not compatible with Firefox due to unmodified APIs and a lack of testing specific to Firefox's WebExtensions framework.
- Adjustments to the manifest file and API calls for Firefox compatibility have not been implemented.
- Comprehensive testing for Firefox functionality has not been conducted, resulting in unresolved compatibility issues

## REQUIREMENTS REPORT

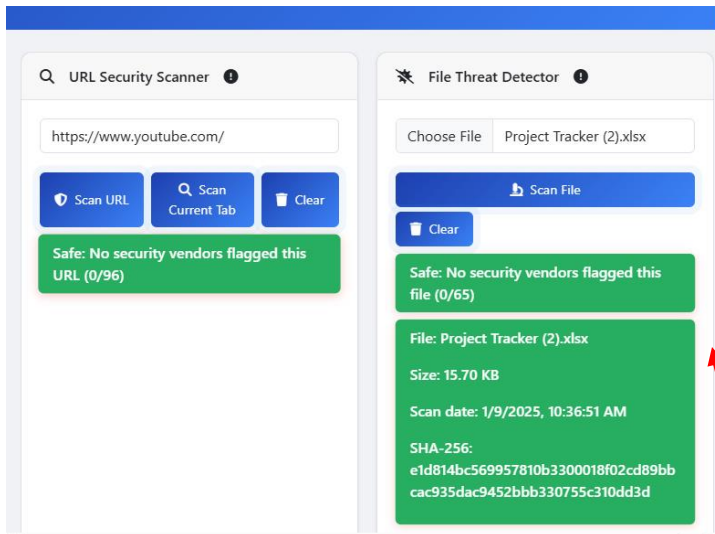


Figure 22: Output 1-Multi-Browser Compatibility

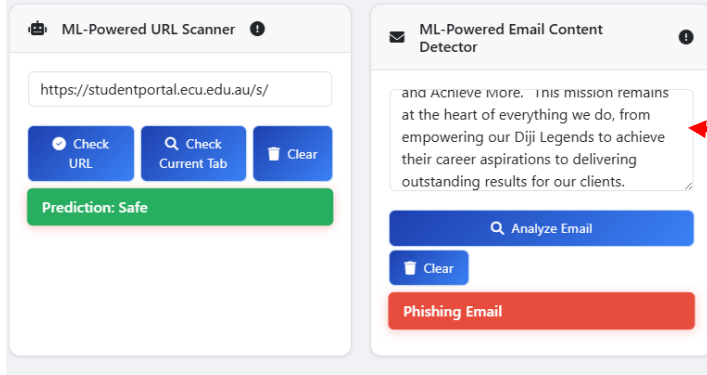


Figure 23: Output 2-Multi-Browser Compatibility

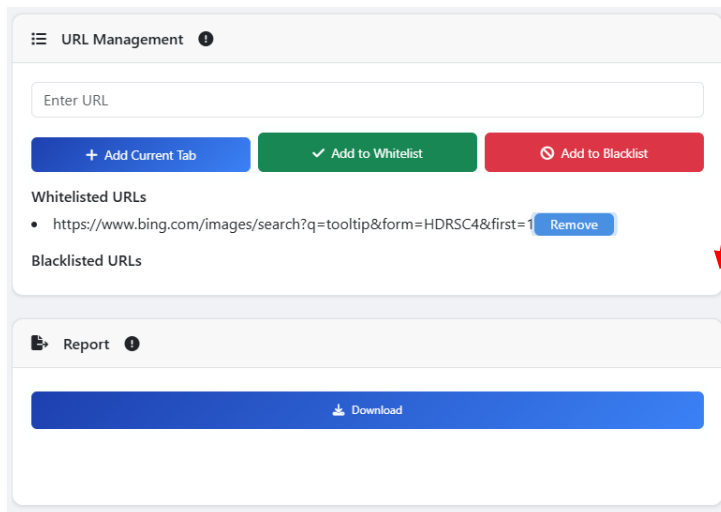


Figure 24: Output 3-Multi-Browser Compatibility

All functionalities are working well for the Edge browser.

## REQUIREMENTS REPORT

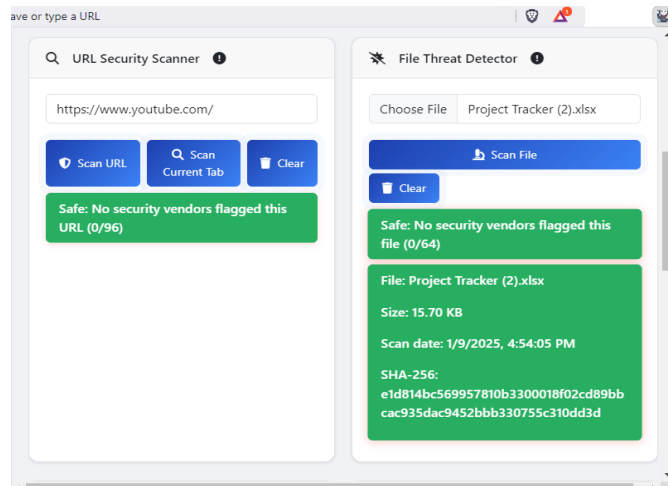


Figure 25: Output 4-Multi-Browser Compatibility

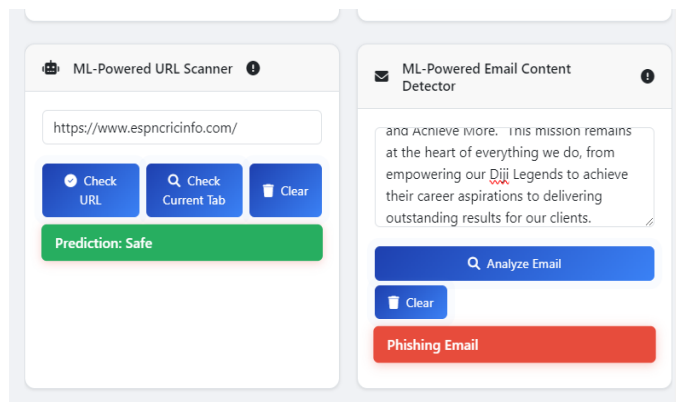


Figure 26: Output 5-Multi-Browser Compatibility

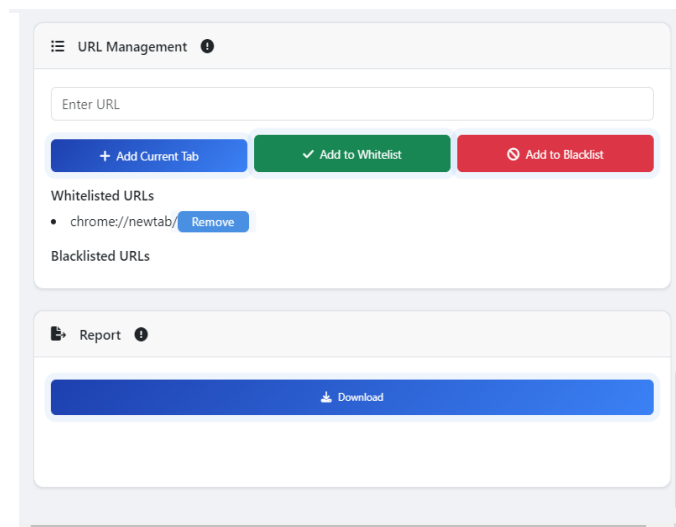


Figure 27: Output 6-Multi-Browser Compatibility

All functionalities are working well for the Brave browser.

Requirement status: **70% implemented**

### 3.9.2 REQUIREMENT: SANDBOX INTEGRATION FOR FILE ANALYSIS

The Sandbox Integration for File Analysis requirement aims to enhance the extension's malware detection capabilities by allowing users to upload files for comprehensive scanning and threat analysis. This feature would utilize VirusTotal's sandbox capabilities to analyze files for known malware signatures and behavioral patterns. The sandbox environment simulates file execution to detect hidden threats, such as zero-day vulnerabilities, that may not be identified through static analysis alone. By integrating this feature, users would gain a robust tool to verify the safety of files before opening them, reducing the risk of malware infections. This capability would be particularly valuable for assessing files received from untrusted sources, such as email attachments or downloads from unknown websites.

#### 3.9.2.1 IMPLEMENTATION

The implementation of Sandbox Integration for File Analysis allows users to analyze files for malware using VirusTotal's database, ensuring comprehensive threat detection and user security.

##### File Upload Interface

- A dedicated File Upload section was added to the extension's popup interface.
- The interface includes:
  - A "Choose File" button allowing users to select files from their local system.
  - A "Scan File" button to initiate the malware scanning process.
- Upon selecting a file, the interface displays the file name and size to confirm the user's selection.
- If no file is selected, a user-friendly prompt reminds the user to upload a file.

##### File Validation

- Basic validation ensures that the uploaded file is of an acceptable type and size (e.g., less than 32 MB, the limit for VirusTotal API).
- Unsupported file types or oversized files trigger an error message, guiding users to upload a valid file.
- A hash (e.g., SHA-256) is computed for the uploaded file.
- The hash is sent to VirusTotal to check if the file has been previously scanned in their database.
- If the file's hash is not found in VirusTotal's database, the system displays a message: "This file has not been scanned before"

##### File Scanning with VirusTotal API

- Instead of uploading the file, the extension uses the computed hash to query VirusTotal's database.
- If the hash exists, VirusTotal returns a detailed report about the file's safety status.



## Analysis and Result Processing

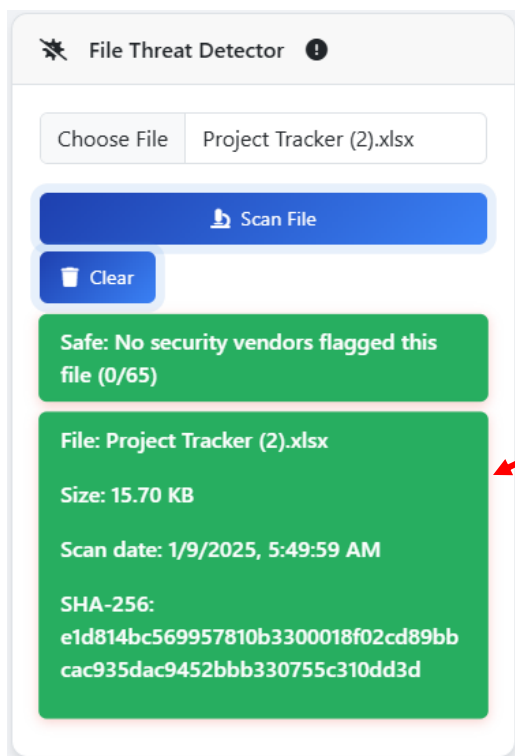
- The API returns a detailed report, including:
  - The number of security vendors that flagged the file.
  - Specific details about the flagged threats.
- Results are categorized into:
  - **Safe:** No threats detected.
  - **Suspicious:** Minor risk identified.
  - **Malicious:** High risk detected.

## Real-Time Notifications

- For files flagged as suspicious or malicious, a browser notification alerts the user of the threat.
- The notification provides a summary of the results and links to detailed information if available.

## Error Handling

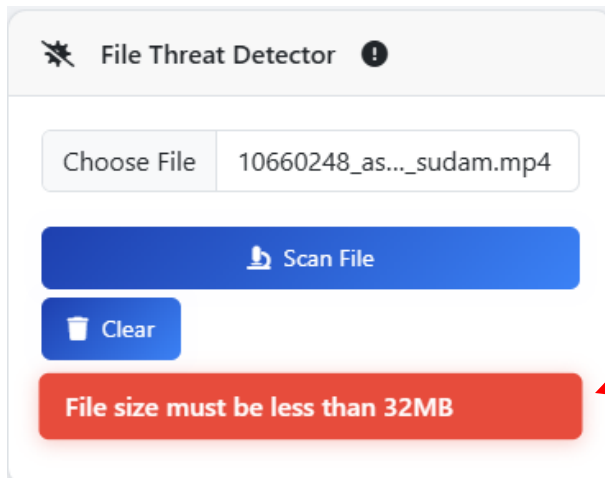
- Files exceeding the API size limit or unsupported file formats trigger error messages.
- If the VirusTotal API is unavailable or fails to process the request, fallback notifications inform users of the issue and suggest retrying later.



Users can get the following details after finishing the uploaded file scan

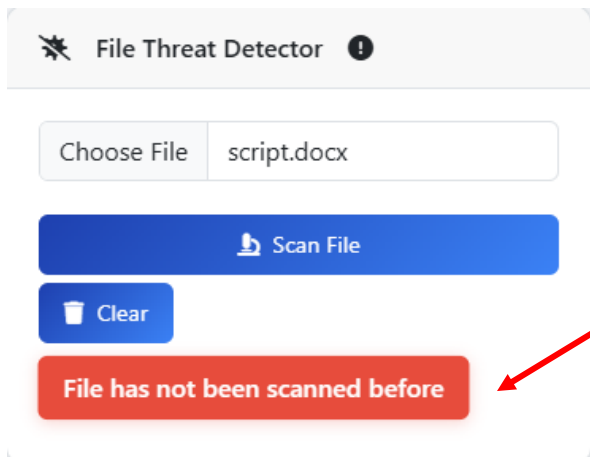
Figure 28: Output 1-Sandbox Integration for File Analysis

## REQUIREMENTS REPORT



when the user uploaded a file higher than 32 MB. The error message shows the file size exceeding the limit.

Figure 29: Output 2-Sandbox Integration for File Analysis



when a user uploads a file that has not been previously scanned. It shows a message.

Figure 30: Output 3-Sandbox Integration for File Analysis

Requirement status: **100% implemented**

### 3.10 SUMMARY OF WON'T-HAVE FUNCTIONAL REQUIREMENTS

The **Won't-Have Functional Requirements** represent features that were deprioritized for this phase of development but were partially or fully explored for potential implementation. While **Multi-Browser Compatibility** was successfully implemented for Edge and Brave browsers, compatibility with Firefox remains unaddressed. The **Sandbox Integration for File Analysis** feature has been fully implemented, leveraging VirusTotal's capabilities to enhance malware detection. These requirements outline the boundaries of the current project scope while highlighting potential areas for future improvement.

Requirement	Requirement Status
Multi-Browser Compatibility	70% implemented
Sandbox Integration for File Analysis	100% implemented

Table 6: Summary of Won't-Have Functional Requirements

### 3.11 SUMMARY OF ALL PROPOSED REQUIREMENTS

Priority	Requirement Type	Requirement	Requirement Status
Must-Have	Functional	Real-Time URL Monitoring	100% implemented
		Phishing URL Detection	100% implemented
		Basic User Alerts	100% implemented
		Whitelist/Blacklist Management	100% implemented
		Basic Malware Detection	100% implemented
		Email Phishing Detection	100% implemented
		Browser Notifications	100% implemented
	Non-Functional	Lightweight and Efficient Design	100% implemented
		User-Friendly Interface	100% implemented
		Compliance with Chrome Policies	100% implemented
		Secure Data Handling	100% implemented
Should-Have	Functional	Severity-Based Alerts	60% implemented
		Email Content Parsing	0% implemented
Could-Have	Functional	Advanced Machine Learning for Phishing Detection	100% implemented
		Heuristic URL Analysis	0% implemented
		Customizable User Settings	0% implemented
Won't-Have	Functional	Multi-Browser Compatibility	70% implemented
		Sandbox Integration for File Analysis	100% implemented

Table 7: Summary of All Proposed Requirements

## 4.0 CONCLUSION

The **Aegis Shield - Phishing Detection Extension** has successfully achieved its primary goals of delivering essential functionalities to safeguard users from phishing and malware threats. The detailed implementation of core features, such as **Real-Time URL Monitoring**, **Phishing URL Detection**, **Basic User Alerts**, and **Whitelist/Blacklist Management**, ensures a secure and seamless browsing experience. Non-functional requirements, including **Lightweight Design**, **User-Friendly Interface**, and **Secure Data Handling**, further reinforce the extension's reliability and usability.

The project also demonstrates significant adaptability through the successful implementation of **Multi-Browser Compatibility** for Edge and Brave browsers and the comprehensive **Sandbox Integration for File Analysis**. These accomplishments highlight the extension's potential to cater to a broader user base while maintaining robust security standards.

While some advanced features, such as **Email Content Parsing**, **Heuristic URL Analysis**, and **Customizable User Settings**, remain unimplemented, the document provides detailed plans and outlines for their future development. These features offer opportunities to further enhance the extension's capabilities and user customization.

In conclusion, the **Aegis Shield - Phishing Detection Extension** fulfills its core objectives and sets the stage for future improvements. This document not only captures the current progress but also presents a clear roadmap for expanding the extension's functionality in subsequent phases, ensuring it continues to provide effective and user-centric protection against evolving cyber threats.