EDUMATE: A DUAL-PURPOSE BROWSER EXTENSION FOR AI-DRIVEN LEARNING AND CYBERSECURITY PROTECTION

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ABSTRACT - In today's digital learning environment, students increasingly depend on online resources and AI tools for academic support. However, this growing reliance on the internet also exposes them to cybersecurity risks such as phishing, data theft, and malicious websites. EduMate provides four key modules: the Ask Module, which delivers step-by-step AI-generated answers to academic queries; the Summarize Module, which converts lengthy notes or articles into concise bullet points; and the URL Safety Module, which detects and warns users about suspicious or phishing links while browsing study materials. By merging AI-powered educational assistance with cybersecurity awareness, EduMate not only enhances students' learning efficiency but also ensures a safer and more responsible digital learning experience. The project demonstrates the potential of integrating artificial intelligence with security awareness to build intelligent, ethical, and secure educational tools.

KEYWORDS - AI-Driven Learning, E-Learning Systems, Browser Extension, Natural Language Processing, Educational Technology, Cybersecurity Awareness, Phishing Detection, URL Safety Analysis,

1. INTRODUCTION

The integration of artificial intelligence (AI) into education has significantly transformed learning by enabling personalized study support through virtual assistants, automated tutors, and content summarization tools. However, the increasing reliance on online learning resources has simultaneously exposed students to cybersecurity threats such as phishing attacks, malicious websites, data breaches, and misinformation. To address this dual challenge, EduMate is proposed as a browser-based AI study assistant that integrates intelligent learning support with cybersecurity awareness in a single lightweight platform. EduMate offers AI-driven modules for question answering, text summarization, and quiz generation using

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Natural Language Processing (NLP), alongside a URL safety detection module that identifies and warns users about suspicious links during academic browsing. By unifying AI-powered educational assistance with online safety features, EduMate enhances academic productivity while promoting responsible and secure digital learning practices, addressing a critical gap in existing e-learning solutions.

1.1 SCOPE OF THIS PROJECT

This project aims to:

- To design and develop EduMate, a browser-based AI-powered study assistant integrated with cybersecurity awareness features.
- Integrate URL safety detection to identify phishing and suspicious websites.
- Design a Chromium-based browser extension with a simple user interface.
- Integrate OpenAI API for NLP-based educational support.
- Test system functionality and security mechanisms in a controlled environment.
- Promote safe and efficient digital learning practices.
- Improve learning efficiency and productivity through real-time AI support.

The framework is designed for students, self-learners, and educators to enhance academic understanding while ensuring safe and secure online learning through AI-powered assistance and cybersecurity awareness.

2. PROPOSED WORK

This project proposes the development of EduMate, an intelligent browser-based learning framework that integrates AI-driven educational assistance with cybersecurity awareness for secure digital learning.

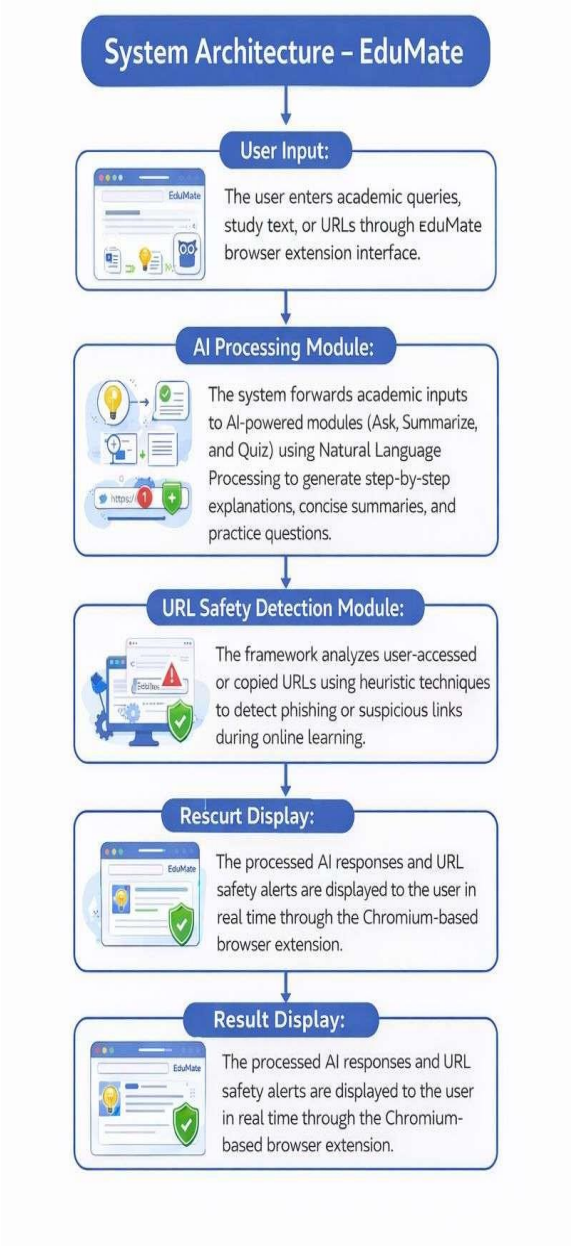
The system combines Natural Language Processing–based learning modules, including question answering, text summarization, and automated quiz generation, to enhance learning efficiency and user engagement.

By leveraging transformer-based AI models and real-time processing, EduMate delivers accurate academic support while minimizing user effort.

The framework also incorporates a URL Safety Detection mechanism that uses heuristic analysis to identify phishing and suspicious links encountered during online learning activities.

The proposed system aims to improve academic productivity, promote cybersecurity awareness, and provide a unified, adaptive solution for safe and intelligent e-learning environments.

2.1 System Architecture



3.1 Data Processing & Preprocessing

To ensure accurate learning assistance and effective URL safety detection, the EduMate framework incorporates the following processes:

- **Data Collection:** Collects academic queries, study text, and URLs directly from the browser extension interface.
- **Input Preprocessing:** Cleans and formats textual inputs to eliminate noise and improve clarity for Natural Language
- **Text Normalization:** Structures and tokenizes input to improve AI-based question answering, summarization, and quiz generation.
- **URL Preprocessing:** Extracts domain information and suspicious patterns for security analysis.
- **AI Model Interaction:** Sends processed data to AI models for learning outputs and URL safety evaluation.

3.2 AI Learning and Safety Mechanisms

3.2.1 AI-Based Learning Assistance:

The AI-based learning module uses transformer-based NLP models to process academic queries, generate step-by-step explanations, produce concise summaries, and create topic-based quizzes. This ensures accurate, context-aware educational support and effective self-assessment.

3.2.2 URL Safety Detection:

The URL Safety Detection module uses heuristic techniques to analyze accessed URLs, identify phishing patterns, and detect unsafe websites. It generates real-time alerts to prevent harmful access and promotes cybersecurity awareness during online learning.

3.3 TOOLS AND LIBRARIES

The EduMate framework employs the following technologies:

- **JavaScript:** Core programming language for browser extension functionality.
- **HTML & CSS:** Used for designing the user interface of the browser extension.
- **OpenAI API:** Provides AI-driven Natural Language Processing for learning modules.
- **RESTful APIs:** Enables secure communication for AI processing and data exchange.
- **Heuristic Analysis Techniques:** Used for detecting phishing and suspicious URLs.
- **Chromium Browser Extension APIs:** Facilitate browser-level interaction and security alerts.

4. PROGRAM

1. manifest.json

```
{
 "manifest_version": 3,
 "name": "Edumate - Learning & Security Assistant",
 "version": "1.0.0",
 "description": "AI-powered learning tools with advanced security features for students",
 "permissions": ["activeTab", "storage", "notifications", "alarms", "tabs", "scripting", "downloads", "contextMenus"],
 "host_permissions": ["https://*/*", "http://*/*"],
 "background": {"service_worker": "background/background.js"},
 "action": {
  "default_popup": "popup/popup.html",
  "default_icon": {"16": "assets/icons/icon16.png", "48": "assets/icons/icon48.png", "128": "assets/icons/icon128.png"}},
 "content_scripts": [
  {"matches": ["<all_urls>"], "js": ["content/content.js"], "css": ["content/content.css"], "run_at": "document_idle"}],
 "options_page": "options/options.html",
 "icons": {"16": "assets/icons/icon16.png", "48": "assets/icons/icon48.png", "128": "assets/icons/icon128.png"},
 "web_accessible_resources": [{resources": ["assets/*"], "matches": ["<all_urls>"]}]}
```

2. background.js

```
console.log('Edumate background service worker loaded');
let securityScanner = null;
let storageHandler = null;
async function initializeUtilities() {
  try {
    await importScripts(
      'utils/api-handler.js',
      'utils/security-scanner.js',
      'utils/storage-handler.js'
    );
    securityScanner = new SecurityScanner();
    await securityScanner.initialize();
    storageHandler = new StorageHandler();
```

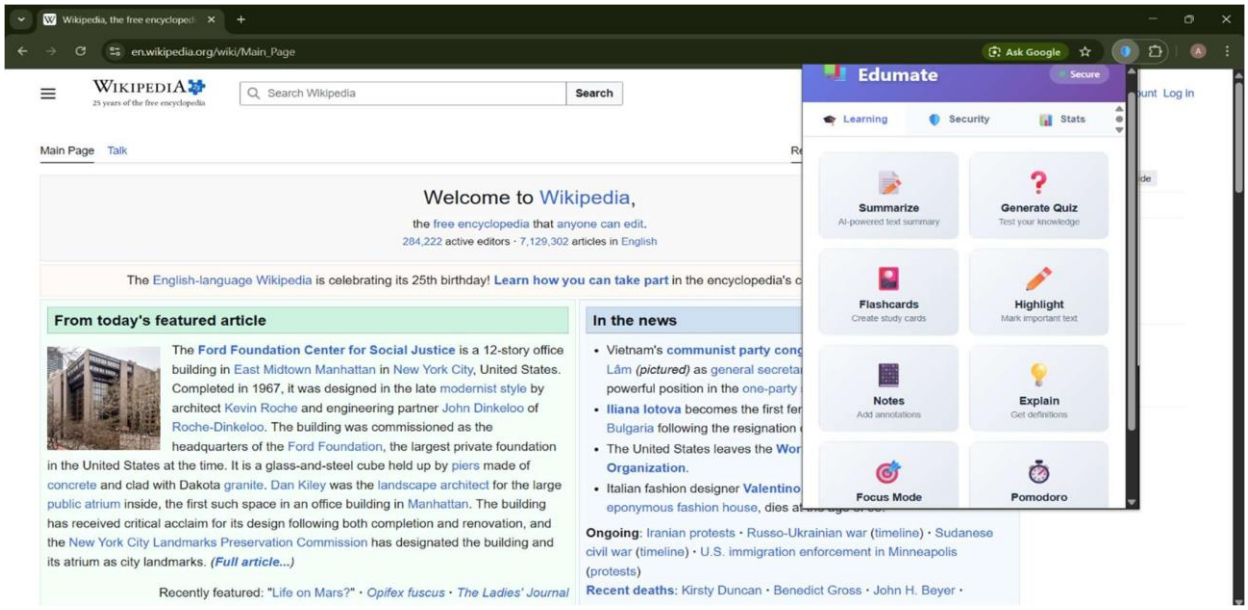
```
    } catch (error) {
        console.error('Failed to initialize utilities:', error);
    }
}
self.addEventListener('install', (event) => {
    event.waitUntil(initializeUtilities());
});
chrome.runtime.onInstalled.addListener(async (details) => {
    await initializeUtilities();
    if (details.reason === 'install') {
        chrome.storage.local.set({
            studyTime: 0, tasksCompleted: 0, focusSessions: 0, streak: 0, weeklyProgress: 0, highlights: [], notes: {},
            flashcardDecks: [], securityScans: [], blockedThreats: [], lastActiveDate: new Date().toDateString(),
            enablePhishingDetection: true, enforceHttps: true,enableDownloadScanning: true,
            enablePrivacyProtection: true,
            enableSecurityAlerts:  true
        });
        chrome.tabs.create({  url:  'options/options.html'  });
    }
    createContextMenus();
});
```

3. api-handler.js

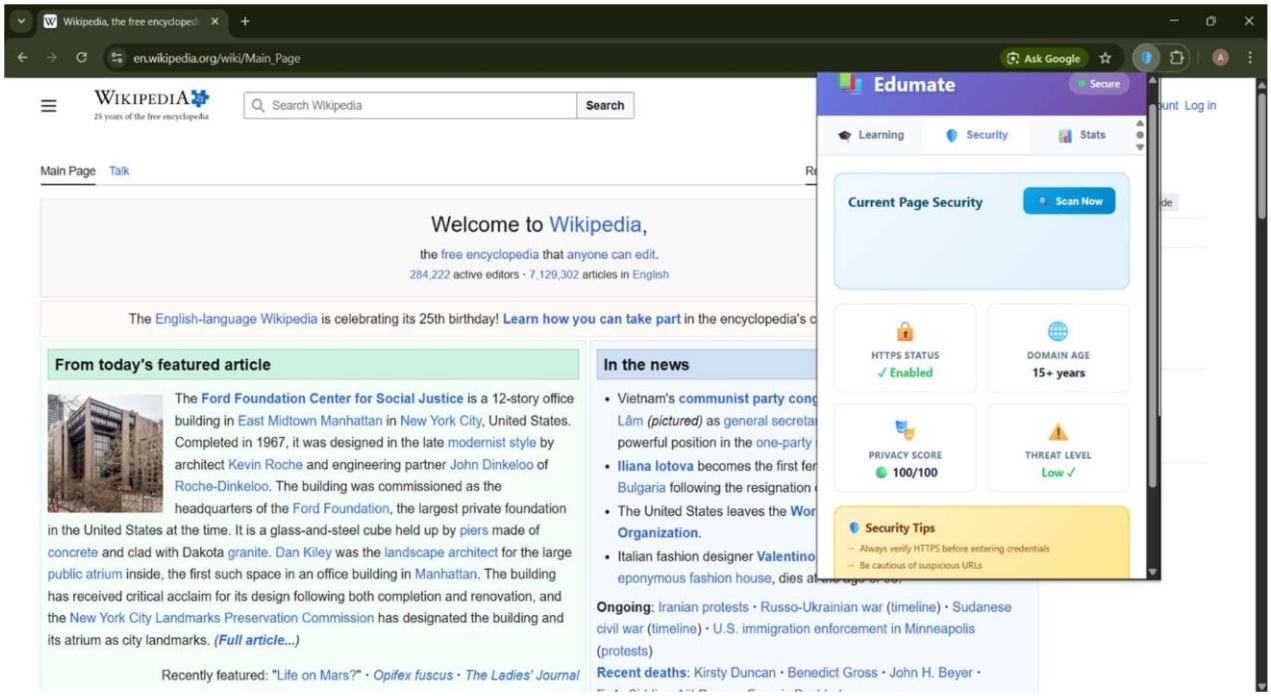
```
class APIHandler {
    constructor() {
        this.loadAPIKeys();
    }
    async loadAPIKeys() {
        return new Promise((resolve) => {
            chrome.storage.local.get([
                'safeBrowsingKey',
                'virusTotalKey',
                'huggingFaceKey'
            ], (data) => {
                this.safeBrowsingKey = data.safeBrowsingKey || '';
                this.virusTotalKey = data.virusTotalKey || '';
                this.huggingFaceKey = data.huggingFaceKey || '';
                resolve();
            });
        });
    }
    async generateSummary(text) {
        if (!this.huggingFaceKey) {
            return this.extractiveSummary(text);
        }
        try {
            const response = await fetch(
                'https://api-inference.huggingface.co/models/facebook/bart-large-cnn',
                {
                    method: 'POST',
                    headers: {
                        'Authorization': `Bearer ${this.huggingFaceKey}`,
                        'Content-Type': 'application/json'
                    },
                    body: JSON.stringify({
```

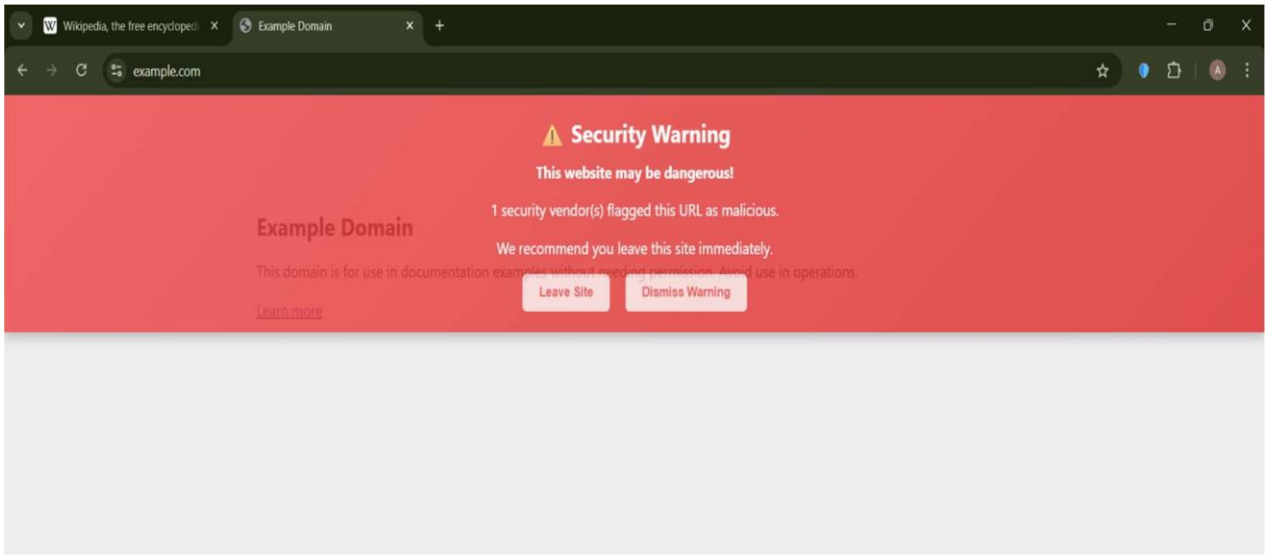
```
                inputs: text.slice(0, 1024),
                parameters: {
                  max_length: 150,
                  min_length: 30,
                  do_sample: false
                }
              })
            }
          );
          if (!response.ok) {
            throw new Error('API request failed');
          }
          const data = await response.json();
          return data[0]?.summary_text || this.extractiveSummary(text);
        } catch (error) {
          console.error('Hugging Face API error:', error);
          return this.extractiveSummary(text);
        }
      }
```

5. RESULTS AND OUTPUT



- **Content Summarization Module:** Generates concise summaries of webpage content.
- **Quiz Generation Module:** Creates questions to assess understanding.
- **Flashcard Creation Module:** Converts key concepts into revision cards**.**
- **Highlighting Tool:** Marks important text on webpages.
- **Notes Module:** Adds user annotations for reference.
- **Concept Explanation Module:** Simplifies complex terms and concepts.
- **Focus Mode:** Reduces distractions during learning.
- **Pomodoro Timer:** Supports structured study intervals.





- **Page Security Scan**: Analyzes the current webpage for potential threats.
- **HTTPS Status Check**: Verifies whether secure HTTPS is enabled.
- **Domain Age Analysis**: Assesses trust based on domain longevity.
- **Privacy Score**: Evaluates data safety and privacy practices.
- **Threat Level Indicator**: Displays overall website risk level.
- **Security Warning Alert**: Notifies users of potentially malicious websites.
- **Safe Browsing Recommendation**: Advises users to leave or proceed with caution.

6. CONCLUSION

The EduMate project effectively integrates AI-driven learning assistance with cybersecurity awareness in a browser-based platform. By offering features such as question answering, summarization, and quiz generation, it improves learning efficiency while the URL safety detection module protects users from phishing and unsafe websites. The system addresses the limitations of traditional AI study tools by combining academic support with online safety. Overall, EduMate provides a practical and secure solution for modern digital learning and supports the development of responsible e-learning practices.

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