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Detoxify: An Automated System to Recalibrate YouTube Recommendation Algorithms Using Intent-Based Content Surfing

Dr. Hingoliwala Hyder Ali, Aaditya Mangesh Patil, Onkar Gidde, Omkar Ambavkar, Aditya Kuyate
MIT ADT-SOC, Pune, India
hyderali.hingoliwala@mituniversity.edu.in, aadityapatil2004@gmail.com
omkargidde241@gmail.com, omkarambavkar12@gmail.com, adityanivrutti.kuyate@gmail.com

Abstract: *The rapid personalization of content on platforms such as YouTube has significantly influenced user behavior, often leading to distraction and reduced productivity due to irrelevant recommendations. This paper presents Detoxify, a client-side browser extension designed to help users realign their YouTube recommendation feed with their intended learning goals. Unlike traditional automation systems, Detoxify operates as a Chrome extension that enables users to initiate controlled "detox sessions," during which the system automatically engages with curated, topic-specific videos using native browser APIs. By leveraging the YouTube Data API and simulating natural viewing behavior through background tab interactions, the system gradually influences the recommendation algorithm toward user-defined interests. The extension also provides real-time feedback through session tracking, progress monitoring, and an algorithm alignment score, allowing users to observe improvements in their content feed. Experimental observations indicate that repeated sessions lead to a noticeable shift in recommendation relevance. This approach promotes digital well-being by transforming passive content consumption into intentional and goal-oriented interaction..*

Keywords: YouTube recommendation algorithm, feed detoxification, automated content curation, algorithmic personalization, digital well-being, browser automation, user interest realignment, content recommender systems, information overload, personalized learning

I. INTRODUCTION

The rapid personalization of content on digital platforms such as YouTube has significantly transformed how users consume information. While recommendation algorithms are designed to enhance user engagement, they often lead to unintended consequences such as distraction, reduced productivity, and algorithmic bias. Users who initially seek educational or professional content frequently find their feeds dominated by entertainment-focused or irrelevant videos, a phenomenon that impedes focused learning and digital well-being.

Detoxify addresses this challenge by offering a client-side Chrome extension that enables users to actively reshape their YouTube recommendation feed. The system initiates controlled "detox sessions," during which it automatically engages with curated, topic-specific videos using native browser APIs and the YouTube Data API v3. By simulating natural viewing behavior, the extension gradually influences the recommendation algorithm toward user-defined interests without requiring manual effort.

This paper details the architecture, methodology, implementation, and evaluation of the Detoxify system, contributing to the broader discourse on algorithmic transparency, ethical automation, and digital wellness.

II. OBJECTIVES

The main objective of this research is to design and develop Detoxify, an automated system that helps users regain control over their YouTube recommendation feed by promoting intentional content exposure. The specific objectives are:

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To study and understand the behavioral dynamics of YouTube's recommendation algorithm, focusing on how watch history and engagement metrics influence future content suggestions.
To design an intelligent system that identifies and curates high-quality, topic-relevant videos through the YouTube Data API based on user-selected interests such as programming, technology, or personal development.
To develop an automation mechanism using browser tools capable of simulating authentic user activity, such as watching, pausing, or skipping videos, to replicate genuine engagement patterns.
To integrate the curated and automated systems into a user-friendly web platform where users can easily select their desired topics and initiate the detoxification process with minimal effort.
To evaluate the effectiveness of the automated system in influencing YouTube's algorithm through controlled experiments that measure changes in recommendation patterns before and after using Detoxify.
To ensure ethical automation practices by avoiding the manipulation of engagement metrics such as fake views or likes, thereby maintaining compliance with platform guidelines while focusing on user benefit.
To promote digital well-being by enabling users to transform their YouTube feeds into educational and purposeful spaces that align with their personal or professional goals.

III. RESEARCH GAPS

A. Algorithmic Transparency and Bias Understanding

While deep neural networks drive YouTube's recommendation system [1], limited transparency exists in how user data influences content suggestions. Research is needed to uncover the internal mechanisms of these algorithms, measure bias in recommendations, and develop interpretable models that promote fairness and accountability [2].

B. Detection and Prevention of Rabbit-Hole Effects

Current literature highlights the "rabbit-hole" phenomenon, where users are progressively exposed to more extreme or narrow content [4]. There is a gap in automated systems capable of detecting such recommendation loops in real time and applying corrective mechanisms to diversify content exposure.

C. Impact on Visibility and Engagement

Although studies have analyzed YouTube's effect on visibility and engagement patterns [6], more research is needed to understand how algorithmic personalization can unintentionally marginalize diverse content creators. Future work should focus on balancing algorithmic engagement optimization with content diversity and creator equity.

D. Digital Well-being and Psychological Impact

Emerging work has linked algorithmic overexposure to burnout and reduced digital well-being among young users [5]. There remains a gap in designing automated systems that can detect signs of algorithmic fatigue and actively modulate content recommendations to support healthier viewing habits.

E. Content Moderation and Harmful Messaging

Research shows that recommendation algorithms can unintentionally amplify harmful or manipulative content such as pro-tobacco messaging [3]. Future studies should focus on developing automated detoxification models capable of identifying and filtering harmful recommendations without compromising user autonomy or engagement.

F. Adaptive and Ethical Personalization

Existing studies emphasize algorithmic performance but often overlook ethical personalization. There is a need for frameworks that ensure recommendations align with user values and consent, offering personalized yet transparent and ethically aware content suggestions [5].

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IV. METHODOLOGY

A. System Overview

The proposed system, Detoxify, is implemented as a client-side Chrome extension that enables users to actively reshape their YouTube recommendation feed. The extension operates entirely within the browser environment using native Chrome APIs, ensuring lightweight deployment and seamless user interaction. The system identifies user-preferred domains (e.g., DevOps, Golang, Rust, JavaScript) and simulates natural user interactions with relevant, high-quality videos to influence the YouTube recommendation algorithm.

B. Extension Architecture

The system follows a modular architecture consisting of:

- Popup Interface: Allows users to input topics, configure session parameters (number of videos and watch duration), and initiate detox sessions.
- Background Service Worker: Manages the execution of detox sessions, including video retrieval, tab automation, and progress tracking.
- Chrome APIs: Utilized for tab management, storage, notifications, and cookie-based session validation.

C. Data Collection and Topic Categorization

Using the YouTube Data API v3, the system retrieves a curated list of videos based on user-selected keywords and topics. These videos are filtered by view count, recency, engagement rate, and creator activity level. Natural Language Processing (NLP) techniques are applied to extract metadata such as titles, tags, and descriptions to verify topic relevance and eliminate unrelated or clickbait content.

D. Automated Engagement Mechanism

To ensure complete automation, Detoxify leverages browser-native capabilities to simulate user behavior. The system performs actions such as:

- Opening videos in background tabs using the Chrome Tabs API.
- Watching videos for realistic durations based on average watch time per category.
- Liking or skipping videos according to user-defined preferences.
- Periodically clearing watch history to reset algorithmic bias if necessary.

This approach mimics natural viewing patterns and gradually influences the recommendation algorithm without requiring manual user effort.

E. Recommendation Feedback Loop

A feedback mechanism monitors changes in the YouTube recommendation feed over time. By periodically scraping homepage recommendations through browser automation, the system compares the percentage of relevant versus irrelevant content. The results are stored and analyzed using Python-based data analytics tools to evaluate detoxification effectiveness.

F. Session Management and Feedback

The extension tracks user activity and provides feedback through real-time progress indicators during sessions, session logs displaying actions performed, historical data including number of sessions and videos watched, and an algorithm alignment score representing progress toward desired recommendations.

G. User Authentication

The system utilizes the user's existing YouTube login session through browser cookies. No external authentication mechanisms such as OAuth are required, ensuring a frictionless user experience.

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H. Evaluation Metrics

The system's performance is evaluated based on the following metrics:

- Feed Relevance Ratio: Percentage of recommended videos related to selected topics.
- Engagement Efficiency: Number of simulated interactions required to shift the feed.
- Time-to-Detox: Duration taken for a significant algorithmic shift toward relevant content.
- User Satisfaction: Qualitative assessment through optional feedback forms.

I. Ethical Considerations

Detoxify is designed as a user-controlled tool where sessions are initiated manually. The system does not generate artificial engagement metrics such as likes or comments. User credentials are stored securely, and all automated actions are designed to remain within YouTube's usage policies. No content is downloaded or redistributed, ensuring ethical compliance with platform terms of service.

J. Implementation Tools and Technologies

The Detoxify extension is implemented using:

- Frontend: HTML, CSS, JavaScript (Chrome Extension Popup UI).
- Backend Logic: JavaScript Service Worker (Manifest V3).
- APIs: YouTube Data API v3.
- Browser APIs: Chrome Tabs, Storage, Cookies, Notifications, and Alarms.

V. CODE

The following figures illustrate the key implementation components of the Detoxify Chrome extension.

Fig. 1. Manifest file defining permissions, service worker, and extension configuration
Fig. 2. Extension popup interface for entering topic and configuring detox session
Fig. 3. Checking active YouTube login session using browser cookies
Fig. 4. Retrieving relevant videos using YouTube Data API based on user input
Fig. 5. Real-time session logs and progress tracking during detox execution
Fig. 6. Tracking sessions, videos watched, and algorithm alignment score using local storage

VI. RESULTS

The Detoxify browser extension was evaluated through multiple user-initiated sessions to observe changes in YouTube recommendation patterns. The results demonstrate the effectiveness of controlled engagement in influencing algorithmic behavior.

A. Recommendation Shift (Observational)

After multiple detox sessions, a noticeable shift in YouTube recommendations was observed. The feed transitioned from mixed or entertainment-focused content to topic-specific, educational videos aligned with user preferences.

Fig. 7. YouTube Feed Before Detoxification
Fig. 8. YouTube Feed After Detoxification Showing Improved Relevance

VII. CONCLUSION

The proposed system, Detoxify, introduces an innovative and automated solution to one of the most common challenges faced by digital learners—the distortion of personalized YouTube recommendations. By leveraging browser automation, topic-based content curation, and YouTube Data API integration, the system effectively reorients the user's feed toward meaningful and self-selected areas of interest.

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The research emphasizes that recommendation algorithms, while designed for engagement, often unintentionally divert users toward irrelevant or distracting content. Detoxify counters this effect through a structured and ethical automation framework that simulates real user behavior, gradually teaching the algorithm to align with the user's authentic preferences.

Through automated surfing, data-driven feedback loops, and privacy-preserving methods, the system provides a hands-free mechanism to reset and maintain a productive YouTube environment. In the broader context, this research contributes to the ongoing discussion on algorithmic transparency, digital mental health, and ethical automation. Ultimately, Detoxify seeks to empower users to reclaim control over their digital ecosystems and transform algorithmic influence into a tool for personal growth and knowledge enrichment.

A. Future Scope

Future enhancements include expanding the extension to support multiple browsers and platforms such as Firefox and Edge, as well as integrating intelligent recommendation control using machine learning techniques. Incorporating sentiment analysis and emotional state detection could enhance the system's ability to personalize content detoxification while promoting digital well-being. A dedicated mobile application or browser extension could further streamline user access and allow real-time monitoring of feed quality. Finally, ethical frameworks and transparency dashboards can be integrated to ensure that users remain informed about the system's interactions with their accounts, reinforcing trust and accountability in the automation process. Through these advancements, Detoxify can evolve into a comprehensive and responsible digital wellness tool that harmonizes technology with intentional learning and mindful content consumption.

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