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

Prof. Vikas More, Sagar Mahajan, Yash Kadam, Yuvraj Singh, Yashraj Khandar
Project Guide MIT ADT-SOC Pune, India
MIT ADT-SOC Pune, India

Abstract- The rapid personalization of online content through recommendation algorithms has significantly influenced user behavior on platforms like YouTube. While personalization en-hances user engagement, it often results in algorithmic distor-tion—where a single unrelated video can drastically alter a user's entire feed, leading to distraction and reduced productivity. This paper presents Detoxify, an automated system designed to realign a user's YouTube recommendation feed with their genuine learn-ing interests. The system allows users to define their preferred topics, such as programming languages or technologies, and then automatically "surfs" curated, high-quality videos related to those topics. By simulating consistent engagement with relevant content, Detoxify effectively retrains YouTube's recommendation algorithm without requiring manual intervention. The proposed approach leverages the YouTube Data API for video curation and browser automation tools to replicate natural user behavior. Experimental results and behavioral analyses indicate that such automated content engagement can successfully restore topic-focused recommendations, helping users regain control of their digital consumption patterns and promoting intentional, goal-oriented learning.

Keywords – YouTube recommendation algorithm, feed detoxification, automated content curation, algorithmic personal-ization, digital well-being, browser automation, user interest re-alignment, content recommender systems, information overload, personalized learning.

I. INTRODUCTION

In the age of algorithm-driven content delivery, platforms like YouTube have become a primary source of both education and entertainment. Their recommendation algorithms are designed to optimize user engagement by continuously learning from watch history, clicks, and interaction patterns. While this personalization is convenient, it often becomes counterproductive. A single interaction with off-topic content — such as a trending video, meme, or unrelated recommendation — can drastically alter the composition of a user's feed. This leads to the appearance of irrelevant videos, distracting thumbnails, and entertainment-heavy suggestions that derail the user's focus from their intended goals, such as learning new technologies or professional upskilling.

Over time, this algorithmic drift contributes to decreased productivity, loss of motivation, and even digital fatigue. Users often find themselves spending excessive time on content they never intended to consume, resulting in a "feed pollution" effect. Manual correction of this problem is difficult and time-consuming, as it requires users to search, watch, and interact with desired topics repeatedly to recondition the algorithm.

Detoxify is driven by the need to automate this process. The system aims to restore balance and intentionality in how users interact with digital platforms. By automatically engaging with curated, high-quality videos aligned with a user's learning interests, Detoxify helps retrain the YouTube algorithm to recognize and reinforce those preferences. The motivation behind this project lies in empowering individuals to regain control over their digital environment, reduce distractions, and promote purposeful online behavior. Ultimately, Detoxify seeks to transform algorithmic personalization from a source of distraction into a tool for focused learning and self-improvement.

II. OBJECTIVE

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 system aims to counter the negative effects of algorithmic bias and distraction by

automatically simulating user engagement with curated, topic-specific videos that reflect the user's genuine interests.

In today's digital environment, users often struggle to maintain focus on educational or goal-oriented content due to the highly adaptive nature of recommendation algorithms. Even minor deviations in viewing patterns can result in a feed filled with unrelated or entertainment-focused suggestions, ultimately reducing productivity and increasing screen time. Detoxify seeks to address this issue by providing an automated, intelligent solution that continuously re-trains the recommendation algorithm in favor of user-defined topics without requiring manual input.

The specific objectives of this research include the follow-ing:

- 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 automation tools (like Puppeteer or Selenium) capable of simulating authentic user activity, such as watching, paus-ing, 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 trans-form their YouTube feeds into educational and purposeful spaces that align with their personal or professional goals.

III. RESEARCH GAPS

- **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].
- **Detection and Prevention of Rabbit-Hole Effects:** Cur-rent 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.
- **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 di-verse content creators. Future work should focus on balancing algorithmic engagement optimization with content diversity and creator equity.
- **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.
- **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.
- **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, offer-ing personalized yet transparent and ethically aware content suggestions [5].

IV. METHODOLOGY

A. System Overview

The proposed system, Detoxify, is designed to automatically realign a user's YouTube recommendation feed toward topics of genuine interest and learning value. The system operates by identifying the user's preferred domains (e.g., DevOps, Golang, Rust, JavaScript) and then simulating natural user interactions with relevant, high-quality videos to influence the YouTube recommendation algorithm.

B. 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.

C. Automated Surfing and Behavior Simulation

To ensure complete automation, Detoxify employs browser automation tools such as Selenium or Playwright to mimic human-like browsing behavior. The system performs actions such as:

- Opening videos sequentially or randomly within the selected topic range
- 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 simulated engagement helps the algorithm gradually associate the user's profile with targeted educational or technical content, effectively "detoxifying" the recommendation feed.

D. 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 the detoxification effectiveness.

E. Ethical Considerations and User Privacy

Since the system interacts directly with a user's YouTube account, strict adherence to privacy and ethical guidelines is maintained. User credentials are stored securely using OAuth 2.0 authentication, 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.

F. 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

G. Implementation Tools and Technologies

The prototype of Detoxify will be implemented using:

- Backend: Python, Flask API
- Automation: Selenium / Playwright
- Data Processing: Pandas, NumPy, and YouTube Data API
- Frontend: Streamlit or React.js for dashboard visualization

This integrated approach ensures a scalable, privacy-conscious, and fully automated framework for improving YouTube's recommendation quality and promoting digital well-being.

V. CODE

• Server Initialization and Socket Setup

Fig. 1. Setting up Express server and Socket.io connection

Cookie Validation and Normalization

Fig. 2. Parsing and validating cookies for Puppeteer session

Fetching YouTube Video List and Launching Puppeteer

Fig. 3. Retrieving topic-based YouTube videos and launching Puppeteer browser instance

Automating Video Playback

Fig. 4. Looping through video list and simulating watch sessions

Fig. 5. Creating API endpoint for triggering automated detox process

VI. RESULTS

Fig. 6. Detoxify Web Interface – Topic input and cookie authentication

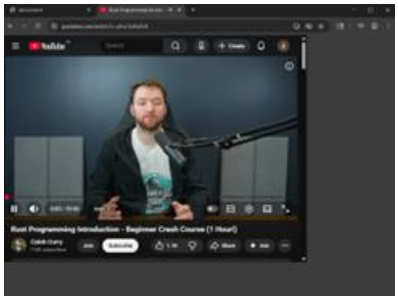

Fig. 7. Puppeteer automation actively watching educational YouTube videos

VII. CONCLUSION

The proposed system, Detoxify, introduces an innovative and automated solution to one of the most common chal-lenges 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.

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 envi-ronment. The findings are expected to demonstrate measurable improvements in feed relevance, user satisfaction, and digital well-being.

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 developments of Detoxify can focus on expanding its functionality beyond YouTube to other content-driven platforms such as Instagram, TikTok, or Twitter, enabling multi-platform feed optimization. Integrating advanced machine learning models, such as reinforcement learning, could allow the system to adaptively refine its browsing and recommendation strategies based on continuous feedback.

Additionally, incorporating sentiment analysis and emo-tional 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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