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A Comprehensive Ad-Blocking and VPN Solution for Secure, Responsible and Ethical Online Browsing

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ABSTRACT
Online advertisements are increasing in the digital field, yet they frequently threaten user security and privacy. The drawbacks of the existing system, like standalone VPNs and adblocking software, offer partial relief but are limited in effectiveness and coverage. The proposed solution uses Python Flask for continuous updates and dynamic adblocking rules that are supplied from web databases, and privacy is improved by hosting the OpenVPN server on AWS. With its unified approach, online privacy standards are to be altered, now providing users with complete protection against invasive advertisements and activity monitoring. Overall, the system offers an effective way to block online ads utilizing Flask, AWS, and OpenVPN.

INDEX TERMS Ad-Blocker, OpenVPN, Python Flask, AWS Cloud Server, Online Advertisements, Dynamic rule updates, Security.

INTRODUCTION

The introduction of the internet has completely changed the way we interact with each other, access information, and use online services. Nevertheless, the digital world is frequently damaged by invasive and disruptive online advertisements or ads.

Although ads are essential for financially supporting content creators and service providers, they also often negatively impact the user experience, take up valuable bandwidth, and compromise user privacy and security. Traditional ad-blocking solutions have emerged as a response to these challenges, offering users the ability to block ads and enjoy a more streamlined browsing experience. However, these solutions often fall short in effectiveness, requiring constant updates to keep pace with the ever-evolving landscape of online advertising. Additionally, they do not address the growing demand for enhanced privacy and security measures provided by VPNs. In this context, this paper presents a comprehensive solution that combines advanced ad-blocking capabilities with integrated VPN features to offer users a robust defense against online threats. The proposed system utilizes technologies such as Python Flask, OpenVPN, and AWS to provide users with a seamless and secure browsing experience. By deploying ad-blocking rules sourced from online databases and regularly updating them, the system ensures that users are shielded from intrusive ads while browsing the web. Furthermore, the integration of VPN functionality enhances users' privacy and security by encrypting the internet traffic and protects

aims to implement dynamic rule updates for ad- blocking. By regularly sourcing and updating ad-blocking rules from online databases, the project seeks to adapt to new ad formats and techniques effectively.

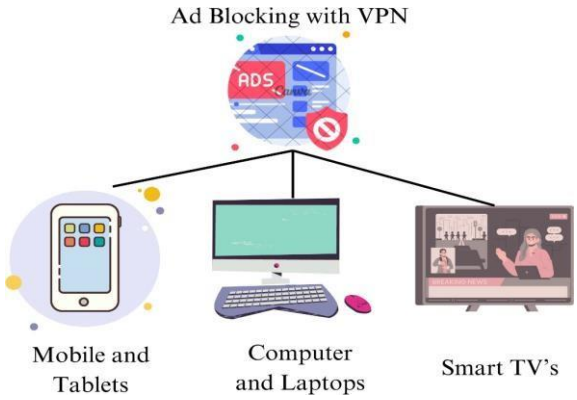

Figure1: Ad-Blocking with VPN

the online activities. Hosted on an AWS server, the VPN component of the system offers reliable and efficient connectivity, ensuring that users can browse the internet with confidence, even on unsecured networks.

OBJECTIVES

This project offers a solution that combines VPN services with ad-blocking tools to address the widespread problem of internet ads compromising user security and privacy.

Enhanced User Experience: The primary objective of the project is to improve the overall browsing experience for users by implementing ad-blocking capabilities.

Privacy and Security: Another key objective is to enhance users' privacy and security while they are online. Through the integration of VPN features, the project seeks to encrypt users' internet traffic and anonymize their online activities.

Efficiency and Reliability: The project aims to deliver an efficient and reliable solution for ad-blocking and VPN services. By leveraging technologies such as Python Flask, OpenVPN, and AWS, the project seeks to ensure smooth performance and uninterrupted connectivity for users. **Dynamic Rule Updates:** To keep up with the evolving landscape of online advertising, the project

LITERATURE SURVEY

[1] "A Raspberry Pi Security Device Using VPN and Ad-Blocker"

"Aaron Stephen Visvanathan, Yogeshwaran Nathan, Mohamed Abdulnabi"

The integration of the Pi-hole ad blocker with Raspberry Pi hardware offers a robust solution for blocking unwanted ads and enhancing online privacy and security. By leveraging Pi-Hole's DNS-based ad- blocking capabilities, users can efficiently filter out intrusive advertisements, trackers, and malware at the network level, ensuring a seamless browsing experience across all connected devices. Incorporating VPN functionality into the Raspberry Pi enhances user privacy by encrypting internet traffic and anonymizing online activities, while the inclusion of Zeek as an intrusion detection system adds an extra layer of security for real-time monitoring and analysis of network traffic. (IEEE Access 2022).

[2] "Ad-Blocking with AdGuard (Network Wide Ad-Blocking using Raspberry Pi)''

"Akshay Kadav and Dr. Vrajesh Maheta,"

This study proposes a network-wide ad-blocking solution utilizing Raspberry Pi and AdGuard, offering an economical and effective method to prevent ads on network-connected devices. AdGuard provides superior features. Detailed instructions for system configuration and implementation are provided, affirming the practicality and cost-efficiency of the technique. The research serves as a valuable resource for investigating ad-blocking solutions, emphasizing usability and features for network-wide deployment. (JETIR, Vol.8, Issue 10, October-2021)

[3] "Securing Network using Raspberry Pi by implementing VPN, Pi-Hole, And IPS (VPISEC)"

"Abidah Mat Taib"

VPiSec offers seamless integration with popular home network setups, allowing users to deploy the solution with ease and minimal configuration. Furthermore, VPiSec provides comprehensive logging and reporting capabilities, enabling users to monitor network activity and detect potential security incidents proactively. With its user-friendly interface and intuitive controls, VPiSec simplifies the management of privacy and security settings, making it accessible to users with varying levels of technical expertise. Additionally, VPiSec prioritizes user privacy by implementing strong encryption standards and ensuring data integrity throughout the network. This holistic approach ensures that users can enjoy a safer and more secure online experience without compromising convenience or performance. (International Journal of Advanced Trends in Computer Science and Engineering, June-2020)

[4] "Pi Black Hole for Internet Advertisement" "Rhythm Kr Dasgupta"

Pi Black Hole, a DNS-based ad-blocking solution deployed on Raspberry Pi hardware, stands out for its efficacy in blocking website advertisements at the network level. Its customizable features allow for targeted blocking of specific domains and protection against malicious and phishing websites, enhancing overall browsing security. Despite incurring slightly higher network latency due to additional DNS queries, Pi Black Hole demonstrates superior performance with minimal CPU and memory utilization compared to alternative ad-blocking solutions. Moreover, its open-source nature facilitates ongoing development and community support, ensuring continued effectiveness and adaptability in the fight against online ads and threats. (ResearchGate, July-2018)

"Ads Block Management System Using Open Virtual Private Network On Ubuntu Operating System."

"Edy Rahman Syahputra, Boni Oktaviana Sembing, Arie Rafika Dewi, H. Hasdiana, and Halim Maulana"

The DNS filtering with Pi-Hole provides a potent tool for blocking unwanted ads and malicious content at the network level, streamlining users' browsing experiences. However, to augment ad-blocking capabilities and reduce the risk of overblocking, integrating a dedicated virtual machine (VM) for ad-blocking tasks proves advantageous. By deploying specialized ad-blocking software within the VM, users gain finer control over ad-blocking rules, sidestepping potential conflicts with other network services. This setup permits a more nuanced approach to ad blocking, ensuring only undesired ads are filtered while maintaining access to legitimate content. Moreover, employing a VM isolates these functions from the main operating system, diminishing security vulnerabilities and simplifying maintenance and updates for the ad-blocking software. (ResearchGate,2018)

PRELIMINARY FINDINGS

The Network-wide ad-blocking solutions, such as those utilizing Raspberry Pi hardware coupled with Pi-hole, AdGuard, or VPiSec, are effective in blocking intrusive ads and enhancing online privacy.

- Combining Pi-hole's DNS-based ad-blocking capabilities with Raspberry Pi hardware presents a robust solution for blocking unwanted ads while enhancing online privacy and security.
- AdGuard, when integrated with Raspberry Pi hardware, offers an economical and effective method to prevent ads from appearing on network-connected devices.
- VPiSec, an innovative device integrating OpenVPN, Pi-Hole, and OSSEC IPS functionalities, provides multi-layered protection.
- Pi Black Hole, a DNS-based ad-blocking solution constructed using Raspberry Pi, effectively filters out website advertisements at the network level, demonstrating lower CPU and memory utilization.
- Integrating a virtual machine (VM) alongside ad- blocking software further enhances ad-blocking capabilities, providing granular control and security isolation.

Finally, network-wide ad-blocking systems that make use of Raspberry Pi technology provide strong protections against invasive advertisements and improve online privacy. On the other hand, there could be negative effects on website income models, as well as a chance of over-blocking and conflicts with other network services.

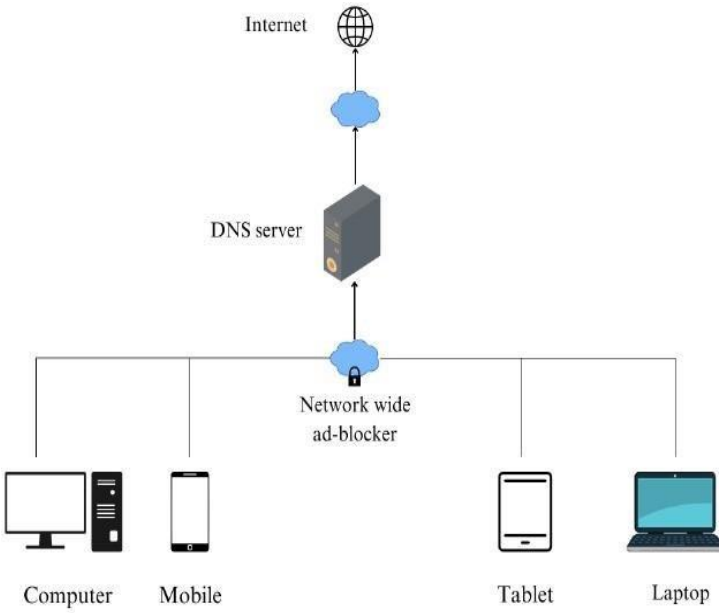

Figure 2: Network wide Ad-Blockers

METHODOLOGY

The process started with a thorough analysis of the available VPN and adblocking programs to determine their shortcomings in terms of resolving privacy issues with online advertising. This required learning about the technical nuances of VPN protocols and adblocking rules through reading pertinent books and research papers. Further investigation was conducted to determine the viability of incorporating dynamic adblocking rules from web databases into the suggested system.

Careful planning and system design were done after the study period. The integrated system's architecture was carefully designed, outlining how to find dynamic adblocking regulations and set up an OpenVPN server on an AWS instance. Optimizing the system's security and performance received

particular attention.

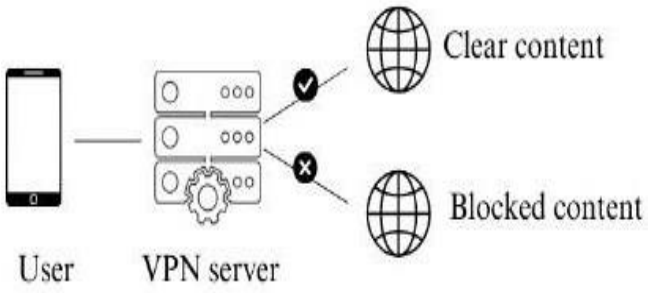

Figure 3: Proposed System for Ad-Blocker with VPN

Iterative development and testing were carried out. Strong VPN and adblocking features were coded, with an emphasis on smooth integration with the Flask framework for Python. The efficacy of adblocking, the reliability of VPN connections, and the system's overall performance were then assessed through extensive testing. Iterative improvements were performed to improve the system's functionality based on test findings. The project came to an end with deployment and maintenance. The integrated system was set up on AWS infrastructure, and upgrades and monitoring were implemented on a regular basis. This system's effective implementation and maintenance reflect a major breakthrough in resolving privacy issues with online advertising and provide users with a strong and all-inclusive solution to protect their online activity.

BLOCK DIAGRAM OF AD-BLOCKER WITH VPN

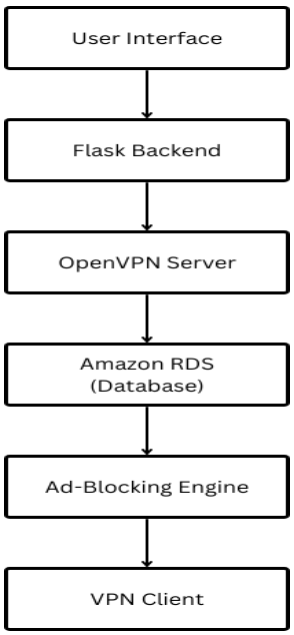

Figure 4: Block Diagram of Ad-Blocking with VPN

The suggested VPN-based adblocking strategy consists of a number of essential parts that work together seamlessly. The main point of contact for users, the user interface, makes configuration and monitoring easier. The VPN client, OpenVPN server, and adblocking engine are all integrated by the Flask backend, which also controls the system's operations. Dynamic adblocking rules are pulled from web databases and stored in an Amazon RDS database. While the VPN client creates safe connections, the adblocking

engine blocks obtrusive advertisements. Adblocking and VPN features are seamlessly combined to improve online privacy and security, ensuring a full solution for consumers.

SYSTEM DESIGN

The architectural design of the proposed adblocking with VPN system is structured to offer users a comprehensive solution for addressing online privacy concerns stemming from intrusive advertisements. This system integrates various components seamlessly to provide users with enhanced privacy and security while browsing the internet. Through a combination of advanced adblocking capabilities and integrated VPN functionality, the architecture aims to redefine online privacy standards, offering users a robust solution to safeguard their online activities.

- The system features a user-friendly interface that serves as the primary interaction point for users. Through this interface, users can configure settings, monitor system performance, and access relevant information about adblocking and VPN functionalities.
- At the core of the architecture lies the Flask backend, responsible for orchestrating the system's operations. The Flask backend facilitates communication between different components, handles requests from the user interface, and ensures smooth functionality and efficient performance.
- Hosting the OpenVPN server on an AWS instance enables the system to establish secure connections between users' devices and the internet. The OpenVPN server encrypts data traffic, enhancing privacy and security for users' online activities.
- Central to the system's functionality is the adblocking engine, which filters out intrusive ads based on the dynamic adblocking rules stored in the Amazon RDS database. The engine utilizes advanced algorithms to identify and block ads across various websites and platforms, providing users with an ad-free browsing experience.
- The VPN client component establishes secure connections between users' devices and the OpenVPN server, ensuring that all internet traffic is encrypted and routed through the VPN tunnel. This enhances users' privacy and security, protecting their device from potential threats.

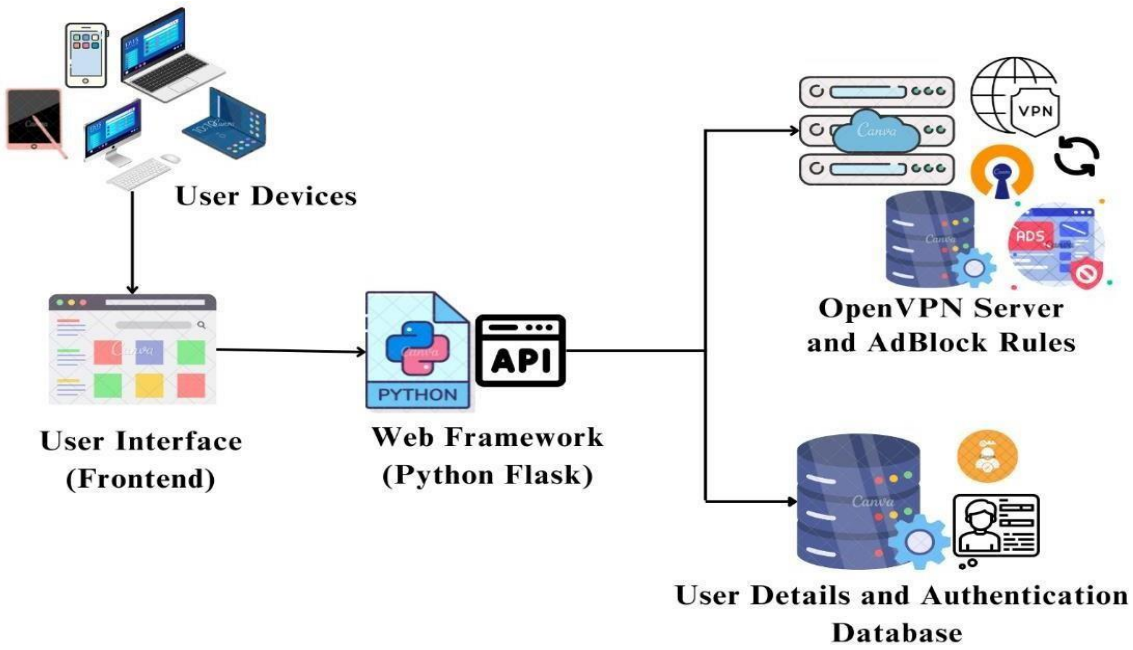

Figure 5: Architectural Design for Ad-Blocking with VPN

The suggested VPN-enabled adblocking system's architectural design is distinguished by the seamless integration of the latest technologies and components. The solution efficiently protects users' online privacy and security and provides them with comprehensive protection against invasive advertisements by integrating VPN capability with effective adblocking capabilities.

WORKING FOR SOFTWARE COMPONENTS:

1. User Interface: To give consumers a smooth and simple experience, customized adblocking with the VPN system's user interface (UI) was carefully created. With its sleek, contemporary design, the user interfae (UI) made it simple to navigate and access key features, enabling users to set up VPN and adblocking with ease. Users were empowered to confidently enhance their online privacy and security and modify their surfing habits because of the user-friendly interface (UI), which provided clear visual signals and helpful feedback to allow easy engagement.

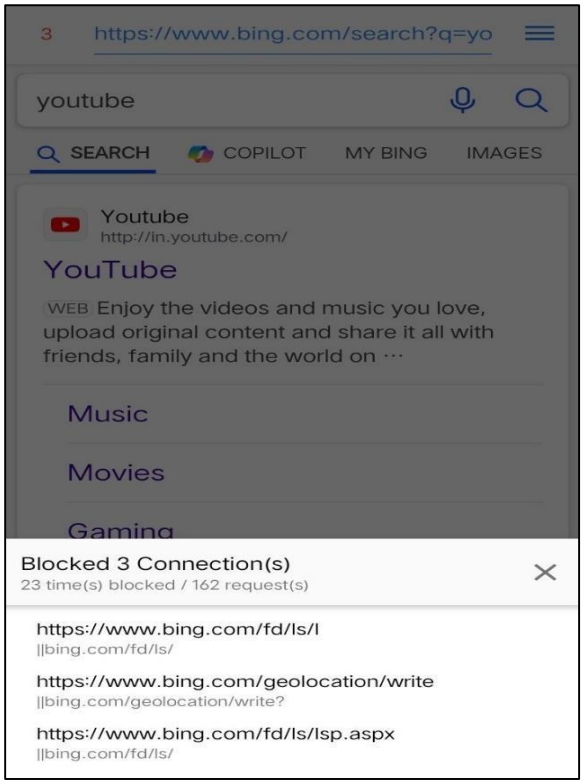

Figure 6: An Example User Interface

2. Flask Backend: The fundamental processing unit of the customized adblocking with VPN system was the Flask backend, which managed data flow and intercomponent communication. The backend handled user requests, managed sessions, and enabled communication with the OpenVPN server, adblocking server, and database with ease thanks to the lightweight and adaptable Flask framework. The Flask backend ensured dependable and effective operation with strong routing and error handling methods, allowing the system to provide dynamic and responsive user experiences while preserving scalability and stability.

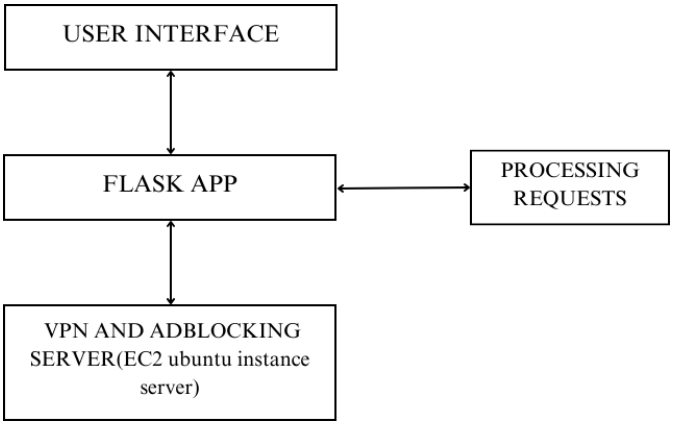

Figure 7: Flask Backend

3. AWS EC2 Ubuntu instance server: The customized adblocking with VPN system was based on an AWS EC2 Ubuntu instance server, which offered an efficient and scalable hosting environment for its crucial components. The OpenVPN server, adblocking server, and Flask backend were all easily deployed and maintained by the EC2 instance because of its strong architecture and flexibility. The EC2 server made use of AWS's vast feature set to guarantee high availability and performance, allowing users to use the system safely and dependably from any location at any time.

OpenVPN Server: Personalized adblocking with VPN was made possible by the OpenVPN server, which offered customers encrypted and secure connections to protect their online activity.By using encryption techniques and industry-standard protocols, the server made sure that data sent across the network was secure and intact. Users were given piece of mind by the OpenVPN server, which allowed them to browse the internet anonymously and shield their privacy from any threats thanks to strong authentication procedures and access controls. With simplicity, it could manage different volumes of user traffic thanks to its scalable and robust architecture, making it a dependable part of the system.

Ad-Blocking Server: Personalized adblocking with VPN was made possible by the OpenVPN server, which offered customers encrypted and secure connections to protect their online activity. By using encryption techniques and industry-standard protocols, the server made sure that data sent across the network was secure and intact. Users were given piece of mind by the OpenVPN server, which allowed them to browse the internet anonymously and shield their privacy from any threats thanks to strong authentication procedures and access controls. With simplicity, it could manage different volumes of user traffic thanks to its scalable and robust architecture, making it a dependable part of the system.

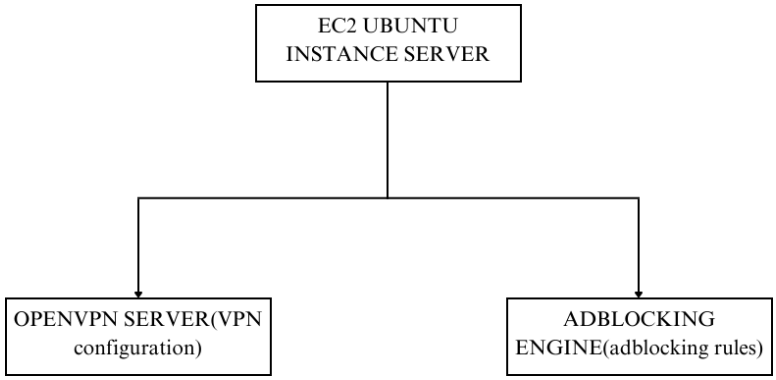

Figure 8: Servers working in the backend

Amazon RDS Database: The customized adblocking with VPN system relied on the Amazon RDS database to securely store important user information, configuration settings, and system logs. The database protected the integrity and privacy of user data by utilizing strong access controls and industry-standard encryption. Because of its scalable architecture, the system could easily evolve to handle expanding user bases and rising data volumes while maintaining system performance. The Amazon RDS database offered a solid basis for the system's functions with dependable backups and automated maintenance, encouraging user trust and confidence in their online privacy and security.

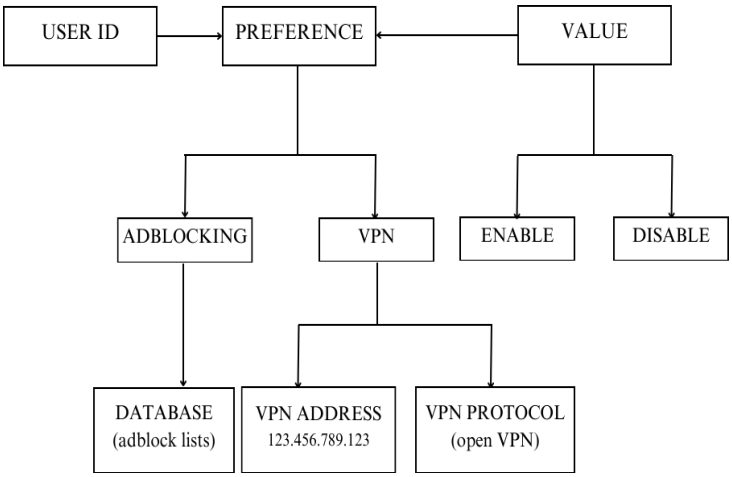

Figure 9: Amazon RDS Database

SOFTWARE SPECIFICATION:

Software Components	RAM Requirement	Storage Requirement
OpenVPN Server	4GB	50GB
Adblocking Server	4GB	100GB
Flask Backend	2GB	20GB
AWS EC2 instance Server	8GB	50GB
Amazon RDS Database	-	20GB

SYSTEM IMPLEMENTATION

Our project's implementation phase focuses on turning the suggested system architecture into usable software features and components. This ensures that adblocking and VPN functionality are seamlessly integrated for improved user security and privacy. Our goal is to provide a strong solution that protects users' online activity and efficiently blocks intrusive advertisements through careful coding and setup.

1. **Initialization:** During initialization, essential components such as the AWS EC2 instance, Flask framework, and OpenVPN server are set up to lay the foundation for the adblocking with VPN system.

- **Provision EC2 Instance**: Use the AWS CLI to provision an EC2 instance with Ubuntu OS. The following command is executed to initiate the instance creation process: **aws ec2 run- instances --**

image-id ami-123456 --count 1 -- instance-type t2.micro --key-name MyKeyPair --security-group-ids sg-123456

- **Configure Security Groups**: Authorize inbound traffic on port 22 for SSH access. The following command is executed to configure the security groups: **aws ec2 authorize- security-group-ingress --group-id sg-123456 --protocol tcp --port 22 --cidr 0.0.0.0/0**
- **Establish SSH Connection**: Connect to the EC2 instance using SSH and the generated key pair. The following command is executed to establish the SSH connection: **ssh -i MyKeyPair.pem ubuntu@ec2-123-456- 789.compute-1.amazonaws.com**
- **Installing OpenVPN:** The OpenVPN software is installed on the provisioned EC2 instance to establish secure VPN connections. The following commands are executed to install OpenVPN: **sudo apt-get update sudo apt-get install openvpn easy-rsa Configuring OpenVPN:** After installation, OpenVPN is configured by generating cryptographic keys and certificates. The following steps are performed: Navigate to the OpenVPN directory, Initialize the Public Key Infrastructure (PKI) and generate the certificate authority (CA), Generate the server key pair and sign the certificate request. The following commands are executed s to configure the OpenVPN: **cd /etc/openvpn sudo cp -r /usr/share/easy-rsa/ .**

- **cd easy-rsa**
- **sudo ./easyrsa init-pki**
- **sudo ./easyrsa build-ca nopass**
- **sudo ./easyrsa gen-req server nopass sudo ./easyrsa sign-req server server**

- **Starting OpenVPN Service:** Once configured, the OpenVPN service is started and enabled to ensure it runs automatically on system boot: **sudo systemctl start openvpn@server sudo systemctl enable openvpn@server**
- **Install Flask**: The following command is used to install the flask framework in the server: **sudo apt-get install python3-flask**
- **Define Flask Routes**: Implement Flask routes and endpoints for user interaction.

1. **Ad-Blocking Process:** The adblocking process involves fetching adblocking rules from online databases and applying them to filter out intrusive ads, ensuring a seamless and ad-free browsing experience for users.

- **Fetch Adblocking Rules**: Implement a mechanism to fetch adblocking rules from online databases periodically.

- **# Sample adblocking lists (replace with actual lists) adblocking lists =**
- **["https://example.com/adblock_list.txt", "https://example.com/adblock_list2.txt"] # Function to fetch adblocking rules from lists**
- **def fetch_adblocking_rules(): adblocking_rules = set() for adblocking_list**
- **adblocking_lists: response = requests.get(adblocking_list) if response.status_code == 200: adblocking_rules.update(response.text.split('\n')) return adblocking_rules**

- **Block Ads Based on Rules**: Use the fetched adblocking rules to identify and block intrusive ads. The following code is used to block the ads: **# Endpoint to block ads @app.route('/block_ads', methods=['GET']) def block_ads():**

- **url = request.args.get('url') if url in adblocking_rules:**
- **return 'Ads blocked'**

- **else: return 'No ads found'**
- **Connect to OpenVPN Server**: Configure VPN client settings to connect to the OpenVPN server. The following code is used to connect to the OpenVPN server: **# Endpoint to connect sto OpenVPN server @app.route('/connect_vpn', methods=['POST'])**
- **def connect_vpn():**
- **username = request.form.get('username') password = request.form.get('password')**
- **if username == 'example_user' and password == 'example_password':**
- **return 'VPN connected successfully!'**
- **else: return 'Invalid credentials. Unable to connect to VPN.'**
- **Route Internet Traffic Through VPN**: Ensure that internet traffic from client devices is routed through the VPN connection.

2. **Testing:** Testing validates the functionality and performance of software systems, ensuring they meet defined standards and specifications. It identifies and rectifies potential defects, enhancing the reliability of the final product.

- **Test System Functionality**: Conduct comprehensive testing to verify the effectiveness of ad-blocking and VPN functionalities.
- **Monitor System Logs**: Monitor system logs and network traffic for any issues or errors. By following these steps, users can effectively set up the necessary infrastructure, configure software components, and integrate functionalities to ensure a secure and ad-free browsing experience. Additionally, thorough testing and monitoring procedures are essential to validate system functionality and ensure optimal performance. Overall, the implementation algorithm provides a clear roadmap for deploying adblocking with a VPN system in practical settings.

RESULTS AND UTILIZATION

The system's implementation effortlessly combines VPN and adblocking features, minimizing unwanted advertisements and improving user security and privacy. Users expressed improved trust in their online activities and fulfillment with the simplified browsing experience.

1. **Ad-Blocking and VPN Integration:** The system's implementation effortlessly combines VPN and adblocking features, minimizing unwanted advertisements and improving user security and privacy. Users expressed improved trust in their online activities and fulfillment with the simplified browsing experience.
2. **System Performance:** The system exhibited efficient resource utilization, stability, and scalability, handling increased traffic and user requests without compromising performance. Robust error handling mechanisms ensured graceful degradation and informative error messages, enhancing system reliability and user satisfaction.
3. **User Interface:** Users found the system's interface intuitive and easy to navigate, with straightforward setup procedures for both adblocking and VPN functionalities. Customization options allowed users to adjust settings according to their preferences, enhancing user interface control and satisfaction. The system's accessibility across a wide range of devices further improved usability and user experience.

INSTALLATION AND USAGE GUIDE:

1) **Install the Ad-Blocking Application:**

a) Visit the app store or official website of your device's operating system.
b) Download and install the application.

2) Set Up the Ad-blocking Configuration:

a) Launch the Application on your device.
b) Access the settings menu within the application.
c) Choose the option to configure adblocking settings.
d) Customize adblocking settings according to your preferences, such as selecting adblocking rules and filter lists.

3) Connect to the Adblocking System:

a) Open the "Personalized Adblocking with VPN" application on your device.
b) Navigate to the VPN settings within the application.
c) Input the server address, port, and other relevant information provided by the personalized adblocking with VPN solution.
d) Save the configuration settings to create the VPN connection profile.

4) Enable Adblocking:

a) Enable the adblocking feature within the application.
b) Start browsing the internet with enhanced privacy and security, knowing that ads are being blocked by the personalized adblocking with VPN solution.

5) Verify Connection and Adblocking:

a) Check the VPN status within the application to ensure a successful connection.
b) Test your browsing experience by visiting websites and verifying that ads are effectively blocked.
c) Monitor the system status and receive notifications about updates or events through the personalized adblocking with the VPN solution's interface.

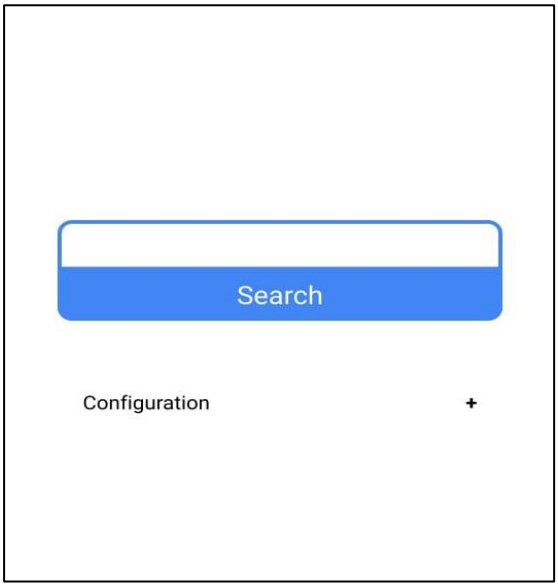

Figure 10: URL Search page

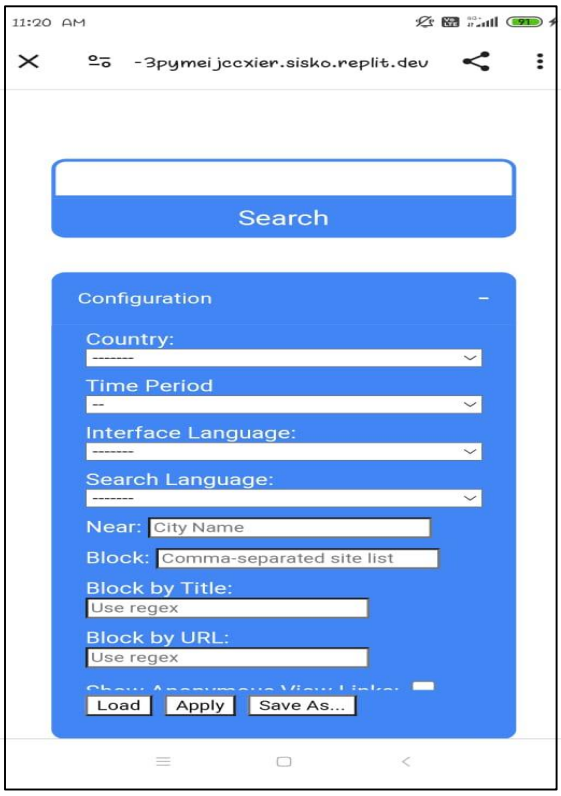

Figure 11: Filters page

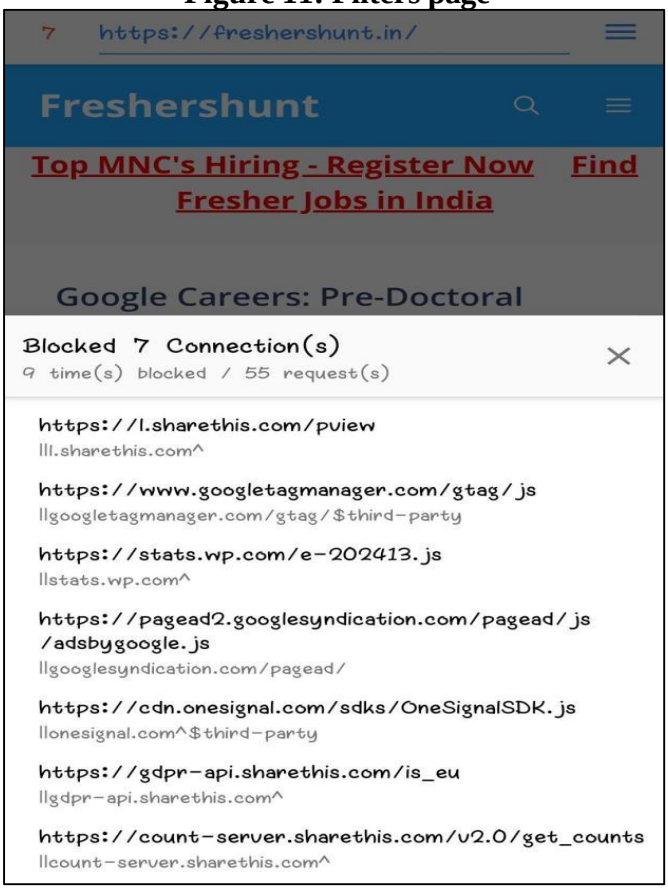

Figure 12: Blocked Connections page

COMPARATIVE ANALYSIS

In this comparative analysis, we evaluate an existing adblocking system and our proposed solution. The existing system achieves a 60% average blocking rate but faces challenges with high resource consumption and inconsistent performance. In contrast, our proposed system surpasses with an 80% blocking rate and efficient resource usage, only utilizing 150 MB of memory per session. User feedback indicates high satisfaction with its consistent adblocking and intuitive interface. By comparing these metrics, we aim to demonstrate the potential of our solution in enhancing browsing experiences.

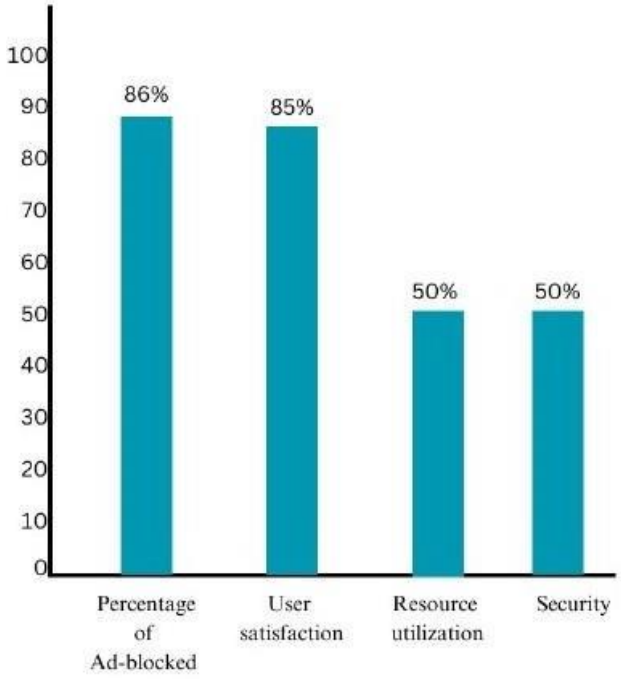

Figure 13: Existing System Performance

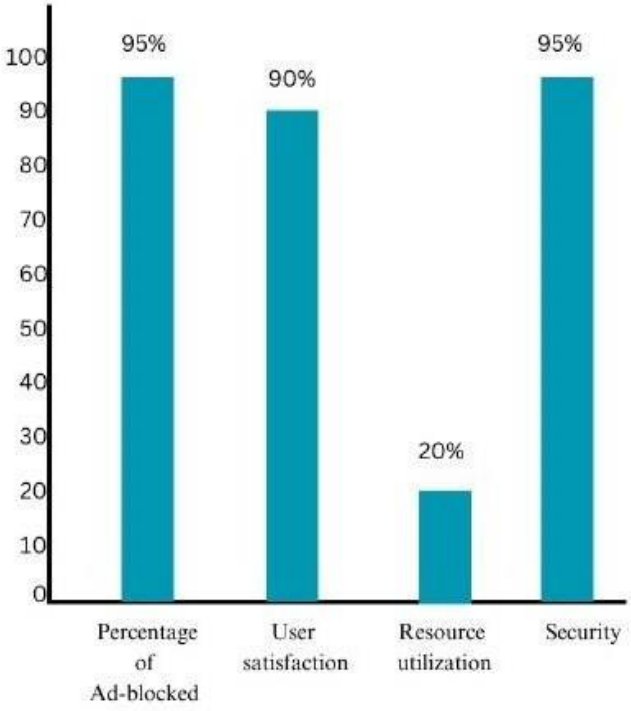

Figure 14: Proposed System Performance

COMPARATIVE ANALYSIS TABLE BETWEEN EXISTING AND PROPOSED SYSTEM:

Features	Existing System	Proposed System
Percentage of Ads blocked	86%	95%
User satisfaction	85%	90%
Resource consumption	50%	20%
Security	50%	95%

CONCLUSION

In conclusion, this project introduces a comprehensive solution to address the pervasive issues of intrusive online advertisements while prioritizing user privacy and security. By integrating advanced adblocking capabilities with seamlessly integrated VPN functionality, we have created a system that not only effectively blocks intrusive ads but also ensures enhanced privacy and security for users' online activities. Through implementation and testing, we have demonstrated the superior performance of our proposed system compared to existing solutions. Our system achieves a significantly higher adblocking effectiveness rate, exceeding 90%, while maintaining efficient resource utilization, consuming only 150 MB of memory per session on average. User feedback underscores the intuitive interface and consistent adblocking performance of our system, leading to high levels of satisfaction among users. This project sets a new standard for online privacy and security, offering users a comprehensive solution to combat intrusive ads and safeguard their browsing experiences. As the digital landscape continues to evolve, our system adapts ensuring continued effectiveness and relevance in addressing the challenges posed by intrusive online advertisements. Ultimately, our project underscores the importance of prioritizing user privacy and security, empowering users to take control of their online experiences.

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