IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 3, March 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 3, March 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1103065 |

Web Push Notification System

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ABSTRACT: Web push notifications are message alerts sent to a website visitor's device via a browser, which help improve user engagement and conversion rates. By enabling websites to send targeted, personalized notifications even when users are not actively browsing, push notifications can significantly enhance the digital experience for users.In this research project, we developed a push notification system that enables websites to send push notifications to their users with ease. Our system includes features such as A/B testing, which allows randomized experiments on two variants of push notifications to determine which performs better, as well as segmentation, which creates target audiences for more effective message targeting. Additionally, our system includes analytics to help track the performance of notification campaigns in real-time.We used ReactJS for client-side rendering, NodeJS for server-side processing, and MySQL as our database. Our push notification system represents an important step in the evolution of web push technology, enabling businesses and website owners to connect with their audiences more effectively and drive engagement and conversions.

KEYWORDS - Push notification platform, Web push notifications

I. INTRODUCTION

1.1 MOTIVATION

Push notifications are a really common way that websites interact with their customers and potential customers about updates, alerts, and other sort of things. It really is a very convenient way that enables timely updates from developers to the subscribers. But during our project study, we found out couple of pretty apparent drawbacks regarding this current stature of the services available in the market. First of all, the existing platforms begin to charge the website owners a fee after they have sent a particular no. of notifications to the subscribers. So, this sometimes becomes very inconvenient and unaffordable to the websites which still are not generating sufficient income from it. Another one is that existing systems do not offer effective segmentation techniques so the website owners, so correctly targeting the intended audience becomes a problem for the developer. This is what prod us to build our system. In this system, we will aim to overcome the two major drawbacks existing in the current system. We also will offer top-class analytics features to the owners, so that they will be able to accurately view the results of their campaigns and accordingly plan their next steps.

1.2 PROBLEM STATEMENT

While studying the backdrop of this Web push notification platforms, we found out that most services charge their users after a limit, and don't offer comprehensive segmentation features in the application. So, we will be attempting to overcome this current background.

The Unified Push Notification System paper [3] describes a system for handling push notifications on embedded devices and platforms that do not support web apps. This system offers several advantages, including the ability to handle multiple services without the need for multiple web apps, lightweight processing of push messages to save power, and additional security through user authentication. Our system aims to build upon these ideas to overcome some of the drawbacks of existing web push notification platforms.

1.3 OBJECTIVE

The main aim of this project is to build a web push notification system which enable websites to send push notifications to their visitors. Other specific objectives are:

a. To build analytics feature in system which will show analytics of push notifications such as click through rate, failed to send etc.

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b. To build scheduling feature which enables website owners to schedule a push notification at a specific time.
c. To build A/B testing feature which can send two different variants of push notifications to users and compare which works better.

1.4 SCOPE

a. The purpose of the web push notification platform is to create a convenient and easy to use platform which enables websites to send push notifications to their visitors.

b. The system is based on a relational database and able to send push notifications using the push and notifications technology.

c. The platform will support many features such as segmentation which will help sending right messages to the right audience, A/B testing which compares one or more versions of push notifications to see which one performs better etc.

II. EXISTING SYSTEMS

Web push notifications have emerged as a powerful tool for websites to engage with their audiences and drive conversions. However, existing push notification systems lack adequate security measuresto protect against unauthorized access to push messages.G. Saride and colleaguespropose aSecure Web Push System that incorporates a Gateway Client and Gateway Server component to encrypt sent push messages and ensure user privacy and authentication [1].

This system offers improved security features that can help prevent data breaches and ensure that push notifications are only accessed by authorized users. Several popular web push notification systems, such as OneSignal and Firebase Cloud Messaging, offer features such as automation, segmentation, personalization, and scheduling, making it convenient for websites to send notifications to users on desktop and mobile devices. The choice of a specific system may depend on the needs and requirements of the website, such as the target audience, the frequency and type of notifications to be sent, and the desired level of customization and analysis. By leveraging web push notification systems, websites can improve user engagement, drive traffic, and increase conversions.

III. SYSTEM DESIGN

3.1 HOW PUSH NOTIFICATIONS WORK

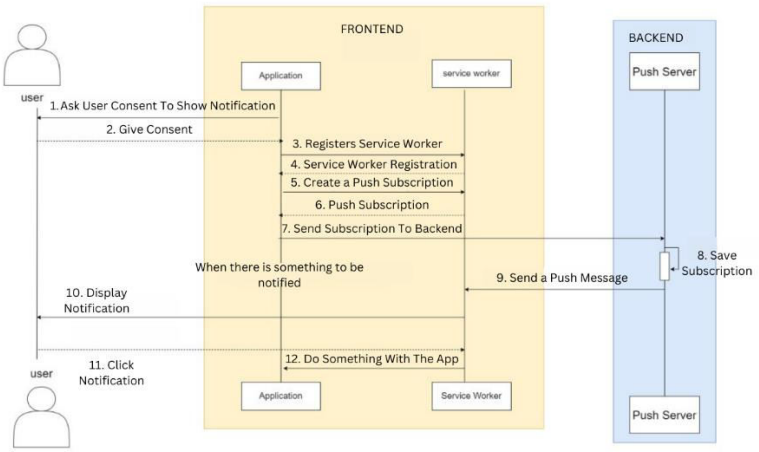

Fig 1: Web push notifications – working overview

1) The process begins by requesting the user's consent to display notifications in the application.
2) The user gives consent to receive push notifications.
3) Upon receiving the user's consent, the application initializes a service worker.

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4) Service worker registration is complete. This service worker can be used by the application to create a push notification subscription, which contains an endpoint used to send push notifications to the subscriber.
5) The browser's push service creates a push subscription.
6) The application receives the push subscription.
7) The application sends this push subscription to the push server.
8) The push server saves this push subscription in the database.
9) Whenever there is a push notification to be sent, the push server sends a message to the endpoint of the push subscription. Service worker receives the message, which has a listener for push events.
10) The service worker displays the received push notification to the user.

11) When the user clicks the push notification, a notification click event is fired and handled by the service worker.
12) Upon receiving the notification click event, the service worker has the freedom to execute various actions with the notification and its associated data, such as displaying a webpage, invoking an API, or implementing any other customized functionality.

3.2PUSH NOTIFICATION SYSTEM ARCHITECTURE

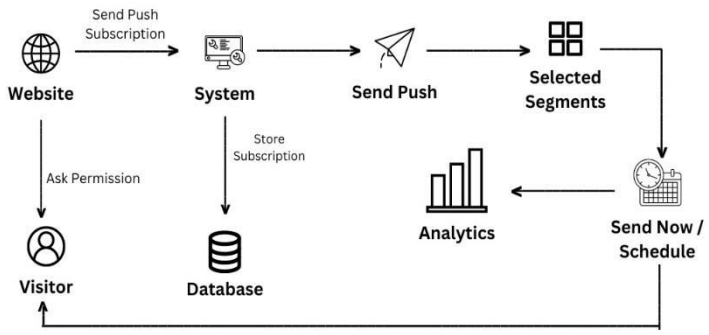

Fig 2: System Architecture

Our system architecture diagram depicts the flow of our web push notification system which starts with the website requesting user permission to receive notifications. Once the user grants permission, the visitor sends a push subscription to our system, which then stores it in the database.

From there, our system provides the option to select specific audience segments for targeted notifications. These segments can be categorized based on various criteria, such as location or behaviour on the website. Once the desired segments are selected, notifications can be sent immediately or scheduled for a later time.

As notifications are sent, our system tracks important metrics such as delivery rates, failure rates, and click-through rates. This data is then analysed to provide valuable insights into the effectiveness of the notification campaign, allowing for continuous improvement and optimization of the push notification strategy.

IV. IMPORTANCE

Push notifications are an important tool for website developers and marketers to engage and retain their users. These notifications are small alerts that pop up on the user's device, even when the application is not currently in use. They can be customized to provide users with relevant and timely information, such as reminders, updates, promotions, or other valuable content.

One of the main benefits of push notifications is their ability to grab the user's attention and encourage them to open the app. This can lead to increased user engagement and usage, which in turn can improve retention rates and drive higher revenues. Push notifications provide a direct and personalized way of communicating, which help build loyalty & trust.

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V. FEATURES

i. **Scheduling**: Allows users to schedule push notifications to be sent at a specific time and date in the future.
ii. **A/B testing**: Enables testing of different versions of push notifications to optimize for better engagement and conversion rates.
iii. **Analytics**: Provides metrics such as open rates, click-through rates, and conversion rates to track and analyse the performance of push notifications.
iv. **Segmentation**: Allows targeting of specific groups of users with customized push notifications based on factors such as user behaviour, location, or interests.

VI. CHALLENGES

While push notifications can be a powerful tool for engaging and retaining users, there are also several challenges in their acceptance. One of the main challenges is the risk of annoying or interrupting users, particularly if notifications are sent too frequently or are not relevant to their interests. Additionally, users may be concerned about their privacy and the use of their personal data for targeting notifications. Finally, users may simply feel overwhelmed by the sheer volume of notifications they receive from different apps, leading them to ignore or disable push notifications altogether. Therefore, it is important for businesses to be thoughtful and strategic in their use of push notifications, providing users with value-added and personalized content while respecting their privacy and preferences.

VII. IMPACT

Push notifications have a significant impact on application users and businesses. On the one hand, push notifications can help users stay informed and engaged with their favourite apps, providing them with valuable information and updates in real-time. This can improve the overall user experience and make users more likely to continue using the service in the future.

On the other hand, push notifications can also have a significant impact on businesses, driving higher engagement, retention, and revenue. By providing users with timely and personalized information, businesses can build stronger relationships with their customers and increase their chances of making a sale. Push notifications can also be used to promote new products or services, offer discounts or coupons, and encourage users to refer their friends and family.

The implementation of web push notifications and customer relationship management has been shown to have a positive impact on increasing sales and customer satisfaction, as demonstrated by the results of a survey conducted by Kameswara Silver e-commerce website. Specifically, 85% of customers were satisfied with the push notification feature implemented on the website. These findings highlight the potential benefits of incorporating web push notifications and customer relationship management into website development strategies [2].

However, it is important to use push notifications carefully and strategically, as they can also be a source of annoyance and frustration for users if they are overused or not relevant.

VIII. FUTURE WORK

i. Developing a self-hosted push notification system to enable website owners to install the system directly on their own server and send push notifications to unlimited subscribers.

ii. Developing direct integrations between our push notification system and popular content management systems (CMS) such as WordPress and Drupal to enable seamless push notification campaigns.

iii. Exploring the potential of Artificial Intelligence (AI) to optimize push notification delivery, such as predicting user preferences, sending messages at optimal times, and adapting content based on user engagement.

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IX. CONCLUSION

In conclusion, web push notifications have emerged as a powerful tool for businesses and website owners to engage with their audiences and drive conversions. By leveraging the real-time, personalized nature of push notifications, businesses can deliver targeted messaging that is more likely to capture users' attention and prompt action. However, effective push notification campaigns require careful planning, attention to user preferences and privacy, and ongoing optimization to ensure maximum impact.

In this paper, we have explored the technical workings of web push notifications, highlighted the key features and challenges of push notification systems, and discussed the potential impact of push notifications on customer engagement and conversion. Additionally, we have presented our own push notification system, including its architecture and features, and discussed future work that can further enhance its capabilities.

Overall, our research suggests that web push notifications can be a valuable addition to businesses' communication strategies, but careful planning and execution are crucial to success. As push notification technology continues to evolve, we expect to see even more innovative uses of this powerful tool to drive engagement and conversions in the future.

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INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.379

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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