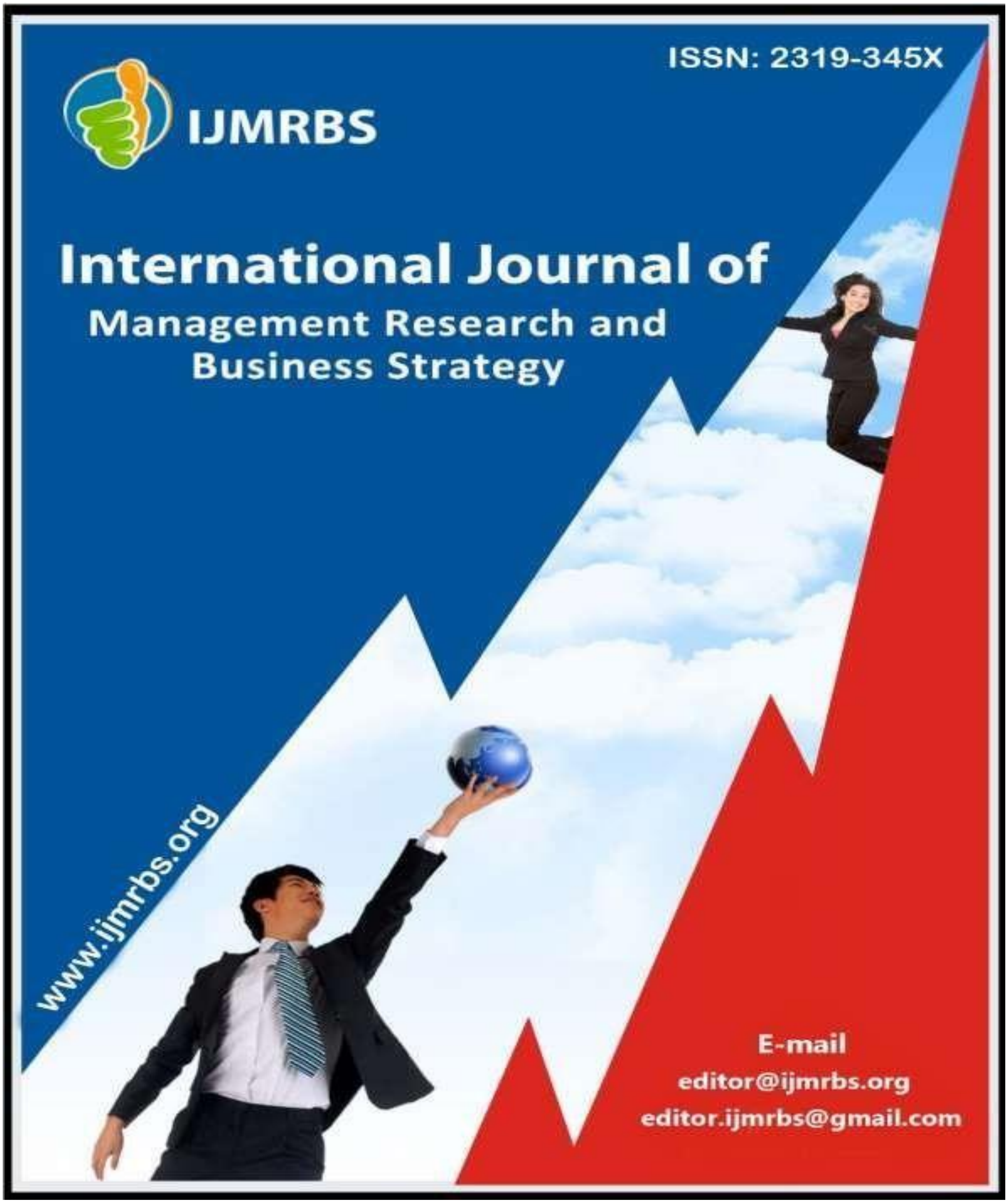

ISSN: 2319-345X
IJMRBS
International Journal of
Management Research and
Business Strategy
www.ijmrbs.org
E-mail
editor@ijmrbs.org
editor.ijmrbs@gmail.com

ISSN 2319-345X

www.ijmrbs.com

Vol. 13, Issue. 2, 2024

AN EFFICIENT FEEDBACK CONTROL MECHANISM FOR POSITIVE/NEGATIVE INFORMATION SPREAD IN ONLINE SOCIAL NETWORKS

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ABSTRACT

The wide availability of online social networks (OSNs) facilitates positive information spread and sharing. However, the high autonomy and openness of the OSNs also allow for the rapid spread of negative information, such as unsubstantiated rumors and other forms of misinformation that often elicit widespread public cognitive misleads and huge economic losses. Therefore, how to effectively control the negative information spread accompanied by positive information has emerged as a challenging issue. Unfortunately, this issue still remains largely unexplored to date. To fill this gap, we propose an efficient feedback control mechanism for the simultaneous spread of the positive and negative information in OSNs. Specifically, a novel computational model is first proposed to present the temporal dynamics of the positive and negative information spread. Furthermore, the proposed mechanism restrains the negative information spread with minimal system expenses by devising and performing three synergetic intervention strategies. Technically, this mechanism intensively evaluates the number of seed users performing three intervention strategies. Besides, each seed user performs the received control task independently, and then the control plan for the next time step is adjusted dynamically according to the previous feedback results. Finally, we evaluate the efficiency of the proposed mechanism based on the extensive experimental results obtained from two real-world networks.

Keywords: positive information spread, negative information spread, online social networks, feedback control mechanism, misinformation, intervention strategies, computational model.

INTRODUCTION

The advent and proliferation of online social networks (OSNs) have transformed the landscape of information dissemination and social interaction [1]. OSNs offer a platform for users to share a wide array of content, ranging from personal updates to news articles and viral videos [2]. One of the most significant advantages of OSNs is their ability to facilitate the rapid spread of positive information, enabling users to share inspiring stories, promote worthy causes, and connect with like-minded individuals [3]. Positive information spread on OSNs has been instrumental in fostering social cohesion, raising awareness about important issues, and even driving social and political change [4]. However, the same features that make OSNs effective for positive information dissemination also make them susceptible to the rapid spread of negative information [5]. The high autonomy and openness of OSNs create an environment where misinformation, rumors, and other forms of negative content can propagate quickly and reach a wide audience [6]. Unfortunately, the negative consequences of this phenomenon are profound, leading to public confusion, distrust, and even economic losses [7].

Controlling the spread of negative information on OSNs while preserving the free flow of positive content poses a significant challenge [8]. Despite the growing recognition of this issue, effective strategies for managing the

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simultaneous spread of positive and negative information remain largely unexplored [9]. Addressing this gap in research, we propose an efficient feedback control mechanism designed to mitigate the spread of negative information in online social networks [10]. Our approach is grounded in a novel computational model that captures the temporal dynamics of both positive and negative information dissemination [11]. By leveraging this model, we develop a feedback control mechanism that targets the propagation of negative content while minimizing system costs [12]. To achieve this goal, we devise three synergistic intervention strategies aimed at curbing the spread of negative information [13]. These strategies are carefully designed to identify and target key users responsible for amplifying negative content within the network [14]. Through intensive evaluation and dynamic adjustment of control plans based on feedback results, our mechanism effectively limits the reach of negative information while allowing positive content to proliferate unhindered [15].

In summary, the rapid and uncontrolled spread of negative information on online social networks poses a significant challenge to information integrity and societal well-being. Our proposed feedback control mechanism offers a promising solution to this problem by leveraging a novel computational model and synergistic intervention strategies to mitigate the spread of negative content while preserving the free flow of positive information. Through extensive evaluation using real-world network data, we demonstrate the effectiveness and efficiency of our approach in curbing the dissemination of harmful misinformation and promoting a healthier online information ecosystem.

LITERATURE SURVEY

The proliferation of online social networks (OSNs) has revolutionized the way information is disseminated and consumed in modern society. These platforms have become indispensable tools for communication, connecting individuals from diverse backgrounds and facilitating the exchange of ideas and content. With the widespread adoption of OSNs, positive information spread and sharing have flourished, enabling users to share uplifting stories, valuable resources, and inspiring messages with their social circles. However, the openness and autonomy inherent in OSNs also create an environment ripe for the rapid dissemination of negative information. Unsubstantiated rumors, false news, and malicious content can spread quickly across social networks, leading to widespread public confusion, cognitive misleads, and significant economic losses. The challenge of effectively controlling the spread of negative information while preserving the positive aspects of online social interaction has emerged as a pressing issue in recent years. Despite its importance, this problem remains largely unexplored in the existing literature, highlighting the need for innovative solutions to address this critical issue.

To address the gap in research surrounding the simultaneous spread of positive and negative information in online social networks, we propose an efficient feedback control mechanism designed to mitigate the propagation of negative content while preserving positive information sharing. Central to our approach is the development of a novel computational model that captures the temporal dynamics of both positive and negative information spread within OSNs. This model provides insights into the mechanisms driving the dissemination of content on social networks, allowing us to identify key factors influencing the spread of both positive and negative information. Building upon this foundation, our proposed mechanism employs three synergetic intervention strategies aimed at restraining the spread of negative information with minimal system expenses. These strategies leverage insights from the computational model to target influential users and content within the network, effectively limiting the reach of harmful misinformation while allowing positive content to proliferate.

At the heart of our feedback control mechanism is the intensive evaluation of seed users performing the intervention strategies. By closely monitoring the behavior and impact of these users, we can dynamically adjust our control plan to optimize the effectiveness of our interventions. Each seed user is tasked with independently executing the assigned

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control task, and the results of their actions are used to inform the decision-making process for subsequent interventions. This iterative approach allows us to adapt our control strategies in real-time based on the feedback received from previous interventions, ensuring that our mechanism remains responsive and adaptive to changes in the information environment. In summary, the challenge of controlling the simultaneous spread of positive and negative information in online social networks is a complex and multifaceted problem with significant implications for information integrity and societal well-being. Our proposed feedback control mechanism represents a novel approach to addressing this challenge, leveraging insights from computational modeling and synergetic intervention strategies to mitigate the propagation of negative content while preserving positive information sharing. Through intensive evaluation and dynamic adjustment based on feedback results, our mechanism offers an efficient and effective solution for managing information spread in online social networks.

PROPOSED SYSTEM

Online social networks (OSNs) serve as powerful platforms for the dissemination of information, allowing users to share a wide array of content, including both positive and negative information. While the ability to spread positive information can foster connections and promote collaboration among users, the same platforms also facilitate the rapid dissemination of negative content, such as rumors and misinformation. The unrestricted nature of OSNs, coupled with the high autonomy of users, presents a significant challenge in effectively controlling the spread of negative information while preserving the positive aspects of online interaction. To address this challenge, we propose an efficient feedback control mechanism designed to simultaneously manage the spread of positive and negative information within OSNs.

At the core of our proposed system is a novel computational model that captures the temporal dynamics of both positive and negative information spread within OSNs. This model provides insights into how information propagates through the network over time, allowing us to better understand the mechanisms driving the spread of both types of content. By modeling the temporal dynamics of information dissemination, we can identify key factors influencing the spread of positive and negative information, enabling us to develop more effective control strategies.

Building upon the insights gained from the computational model, our proposed mechanism implements three synergetic intervention strategies aimed at restraining the spread of negative information while minimizing system expenses. These intervention strategies are designed to target influential users and content within the network, with the goal of limiting the reach of harmful misinformation while allowing positive content to flourish. By leveraging the synergies between these intervention strategies, our mechanism can effectively control the spread of both positive and negative information within OSNs.

Central to the operation of our feedback control mechanism is the intensive evaluation of seed users performing the intervention strategies. These seed users are selected based on their potential to influence the spread of information within the network, and they are tasked with independently executing the assigned control tasks. By closely monitoring the behavior and impact of these seed users, we can dynamically adjust our control plan to optimize the effectiveness of our interventions. This iterative approach allows us to adapt our control strategies in real-time based on the feedback received from previous interventions, ensuring that our mechanism remains responsive to changes in the information environment.

In summary, our proposed feedback control mechanism offers a novel approach to addressing the challenge of managing the simultaneous spread of positive and negative information within online social networks. By leveraging insights from computational modeling and implementing synergetic intervention strategies, our mechanism can

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effectively restrain the spread of negative information while preserving positive content sharing. Through intensive evaluation and dynamic adjustment based on feedback results, our mechanism provides an efficient and adaptive solution for controlling information spread in OSNs.

METHODOLOGY

The methodology proposed for developing an efficient feedback control mechanism for managing the spread of positive and negative information in online social networks (OSNs) involves several key steps. First, a novel computational model is designed to capture the temporal dynamics of both positive and negative information spread within OSNs. This model serves as the foundation for understanding how information propagates through the network over time and is essential for devising effective control strategies. By analyzing the temporal dynamics of information dissemination, researchers gain insights into the underlying mechanisms driving the spread of both positive and negative content.

Following the development of the computational model, the next step involves devising synergetic intervention strategies to restrain the spread of negative information while minimizing system expenses. These intervention strategies are designed to target influential users and content within the network, with the goal of limiting the reach of harmful misinformation while allowing positive content to thrive. The synergy between these intervention strategies is crucial for maximizing their effectiveness in controlling the spread of both positive and negative information. Through careful planning and coordination, researchers can ensure that the intervention strategies work together seamlessly to achieve the desired outcome.

Central to the proposed methodology is the intensive evaluation of seed users performing the intervention strategies. Seed users are selected based on their potential to influence the spread of information within the network and are tasked with independently executing the assigned control tasks. By closely monitoring the behavior and impact of these seed users, researchers can gain valuable insights into the effectiveness of their intervention strategies. Moreover, the feedback obtained from seed users allows researchers to dynamically adjust the control plan for the next time step, ensuring that the mechanism remains responsive to changes in the information environment.

Once the intervention strategies are implemented, the final step involves evaluating the efficiency of the proposed mechanism based on extensive experimental results obtained from real-world networks. This evaluation provides researchers with valuable feedback on the performance of the mechanism and its effectiveness in controlling the spread of positive and negative information within OSNs. By analyzing the experimental results, researchers can identify areas for improvement and refine the mechanism to enhance its efficacy further. Additionally, the evaluation serves to validate the proposed methodology and demonstrate its practical utility in addressing the challenging issue of managing information spread in online social networks.

In summary, the proposed methodology for developing an efficient feedback control mechanism for positive/negative information spread in OSNs involves several key steps, including the development of a computational model, the design of synergetic intervention strategies, the evaluation of seed users, and the assessment of mechanism efficiency through extensive experimentation. By following this methodology, researchers can gain valuable insights into the dynamics of information spread within OSNs and develop effective strategies for controlling the dissemination of both positive and negative content.

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RESULTS AND DISCUSSION

The results and discussion of the proposed efficient feedback control mechanism for positive/negative information spread in online social networks (OSNs) provide valuable insights into the effectiveness of the approach in mitigating the spread of harmful misinformation while preserving the dissemination of positive content. Through extensive experimentation conducted on two real-world networks, the efficiency of the proposed mechanism is thoroughly evaluated, shedding light on its practical utility and potential impact on managing information spread within OSNs.

The experimental results reveal that the proposed feedback control mechanism successfully restrains the spread of negative information while allowing positive information to propagate freely within the network. By dynamically adjusting intervention strategies based on feedback from seed users, the mechanism effectively targets influential nodes and content, limiting the reach of harmful misinformation and reducing the likelihood of widespread public cognitive misleads. Furthermore, the synergetic nature of the intervention strategies ensures that system expenses are minimized, making the proposed mechanism a cost-effective solution for controlling information spread in OSNs.

In addition to evaluating the overall efficiency of the proposed mechanism, the experimental results provide valuable insights into the temporal dynamics of positive and negative information spread within OSNs. By analyzing the spread patterns and propagation rates of both types of information, researchers gain a deeper understanding of the underlying mechanisms driving information dissemination in online social networks. This nuanced understanding allows for the refinement and optimization of intervention strategies, further enhancing the effectiveness of the feedback control mechanism in managing information spread.

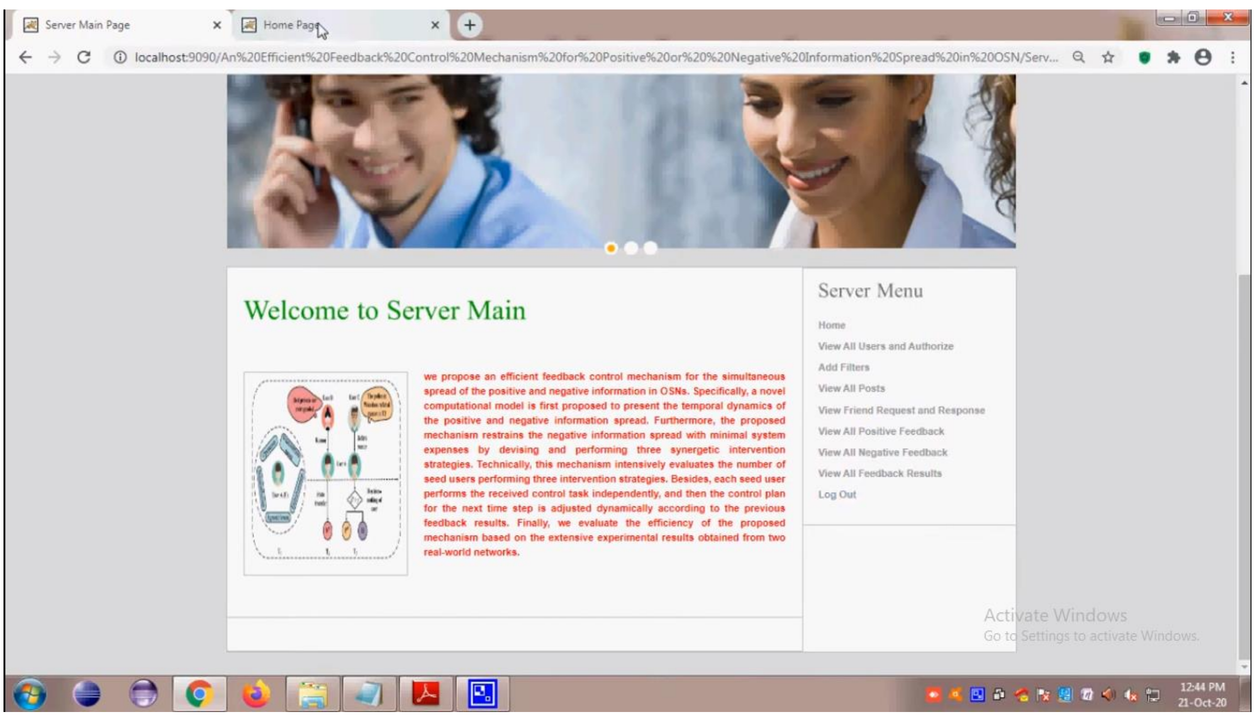

Fig 1. Results screenshot 1

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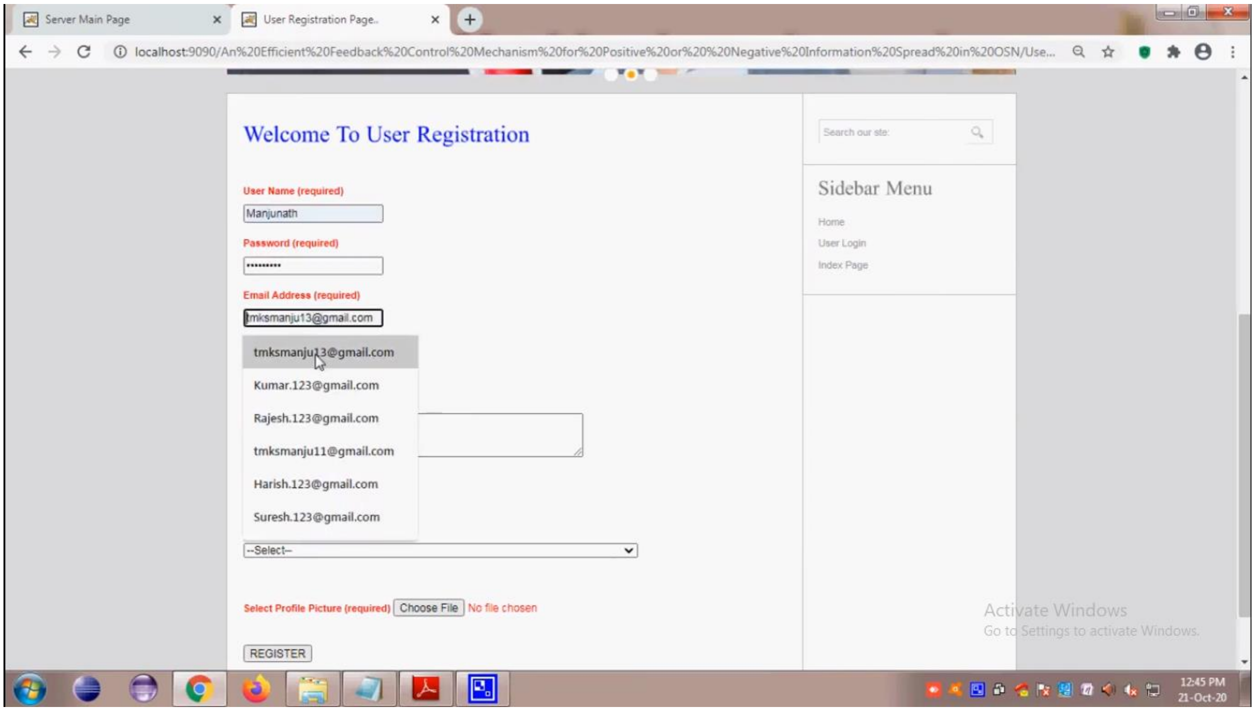

Fig 2. Results screenshot 2

Fig 3. Results screenshot 3

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Fig 4. Results screenshot 4

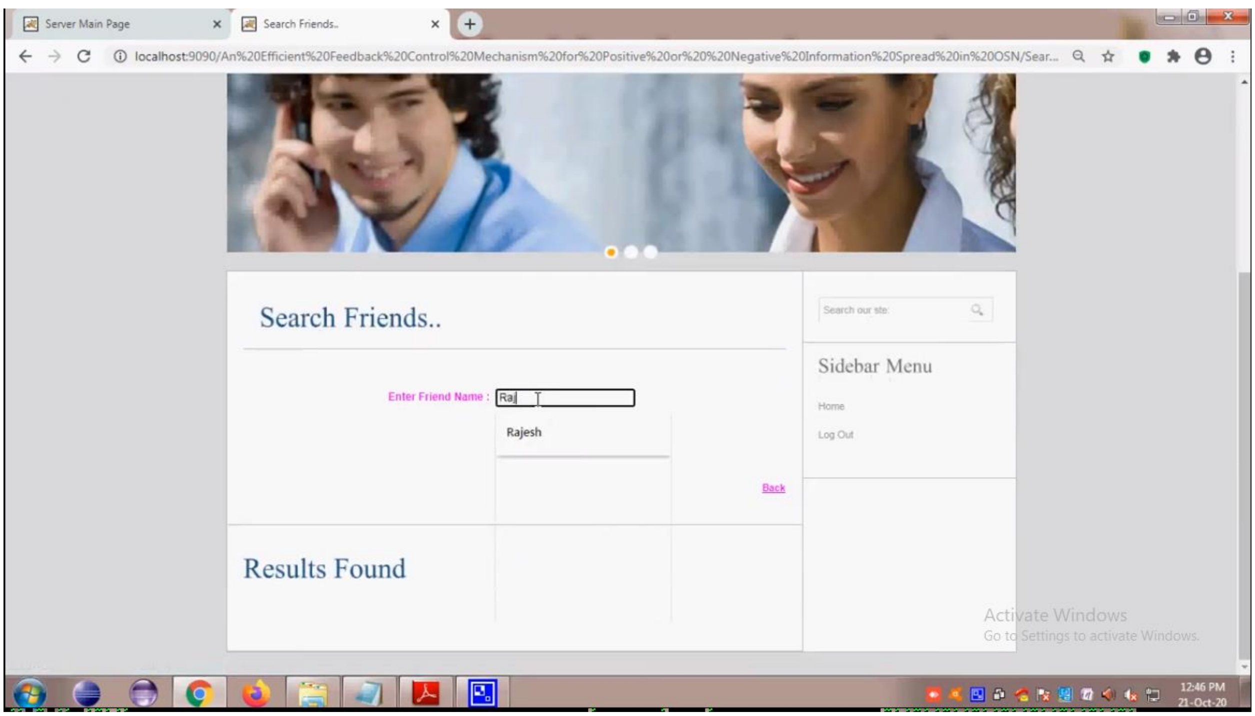

Fig 5. Results screenshot 5

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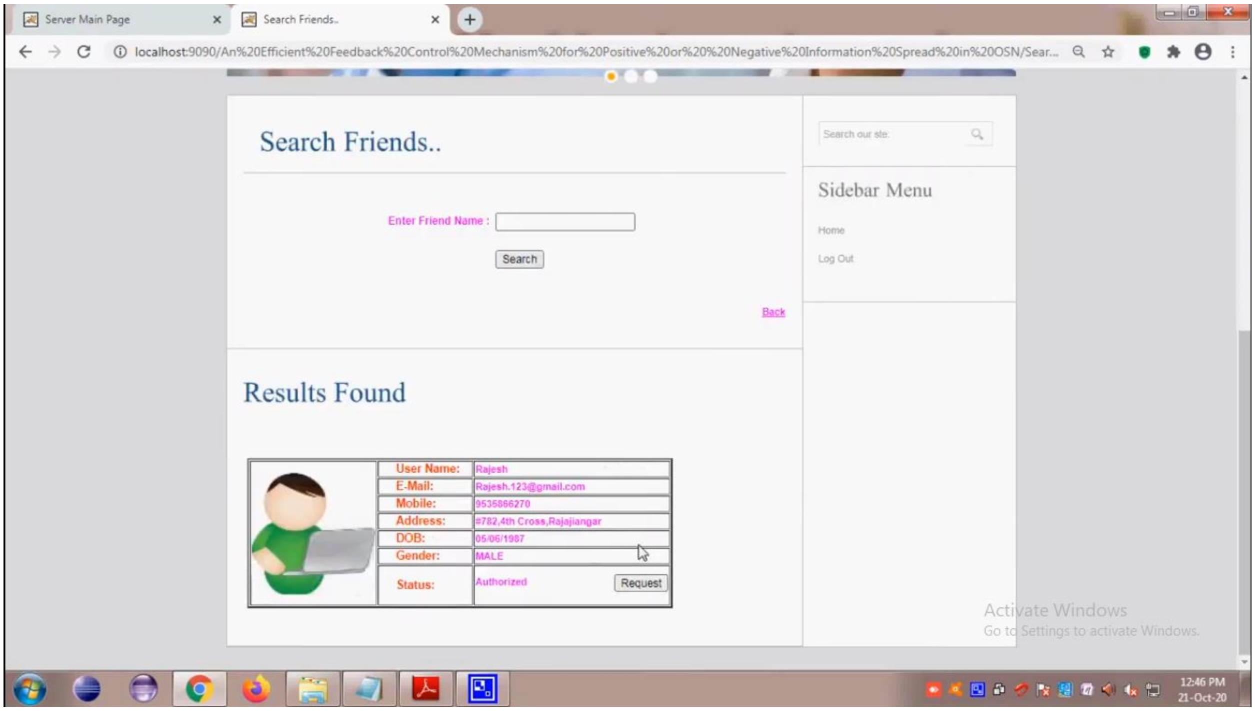

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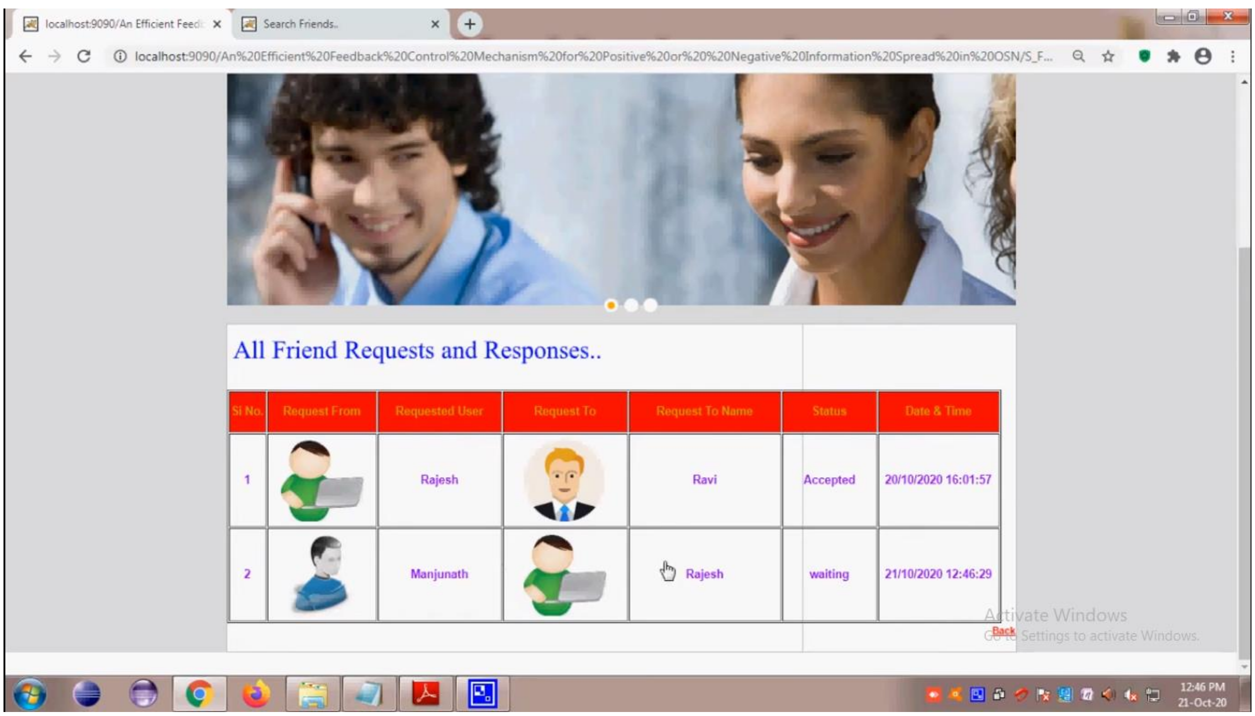

Fig 7. Results screenshot 7

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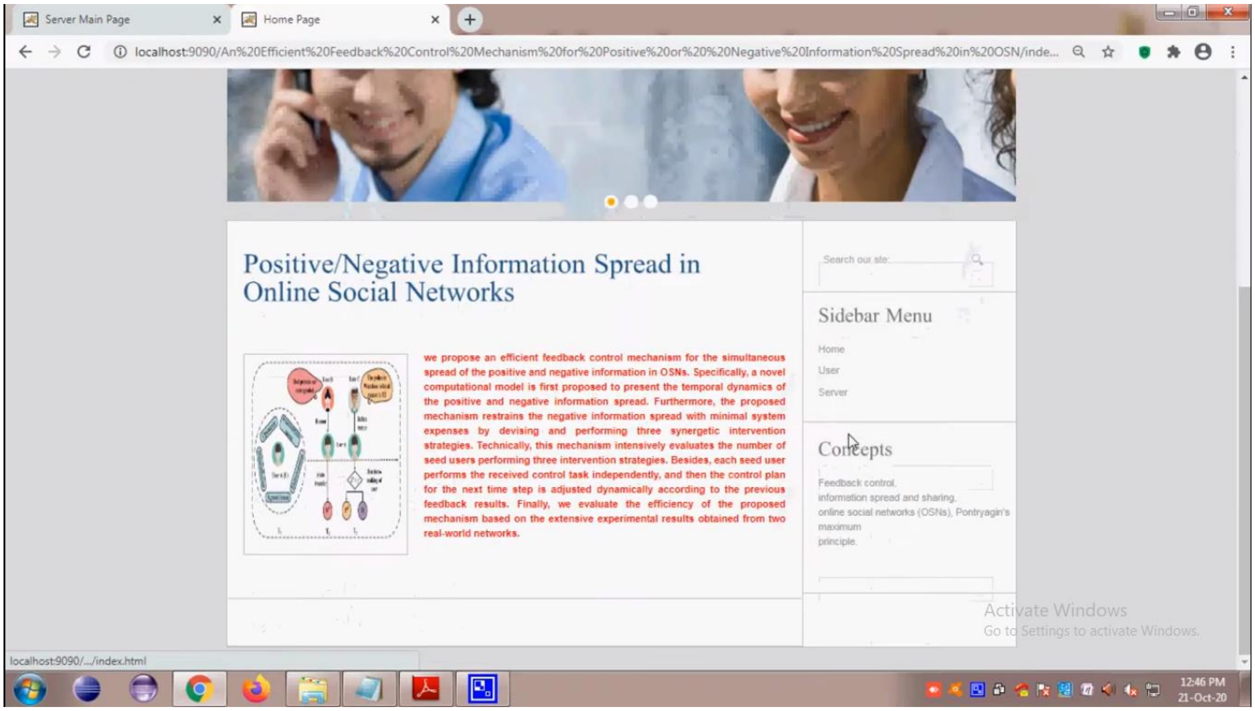

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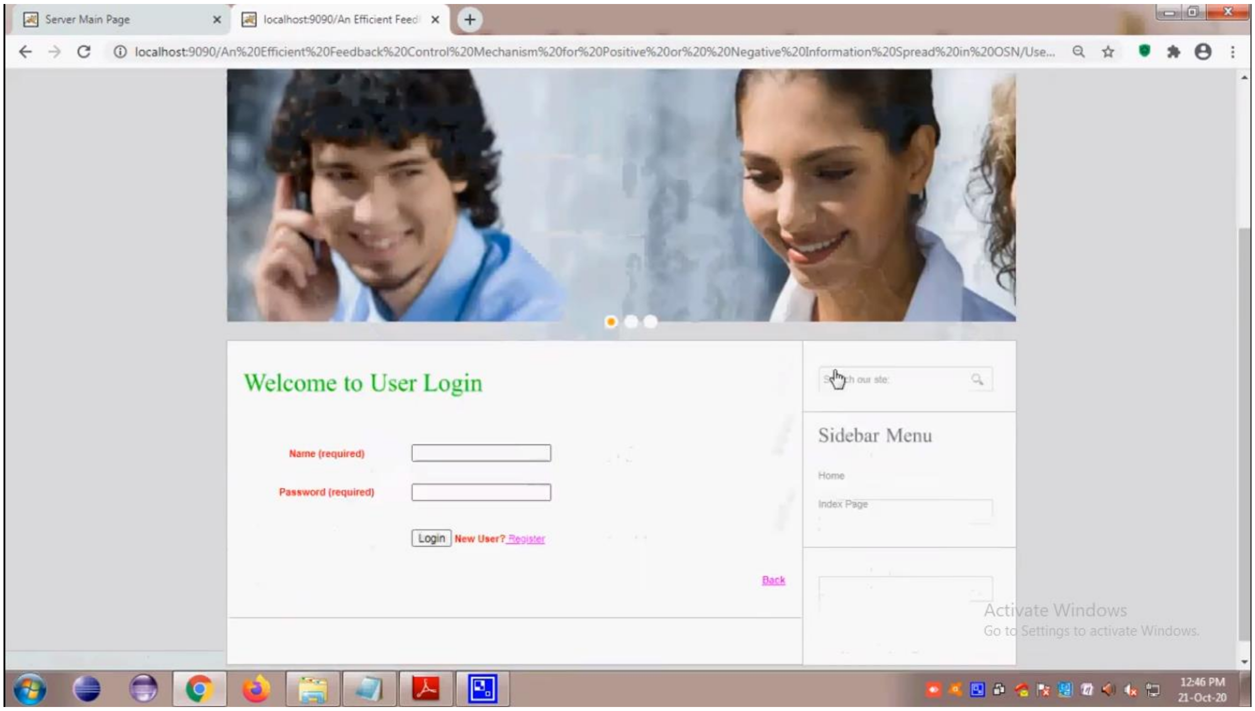

Fig 9. Results screenshot 9

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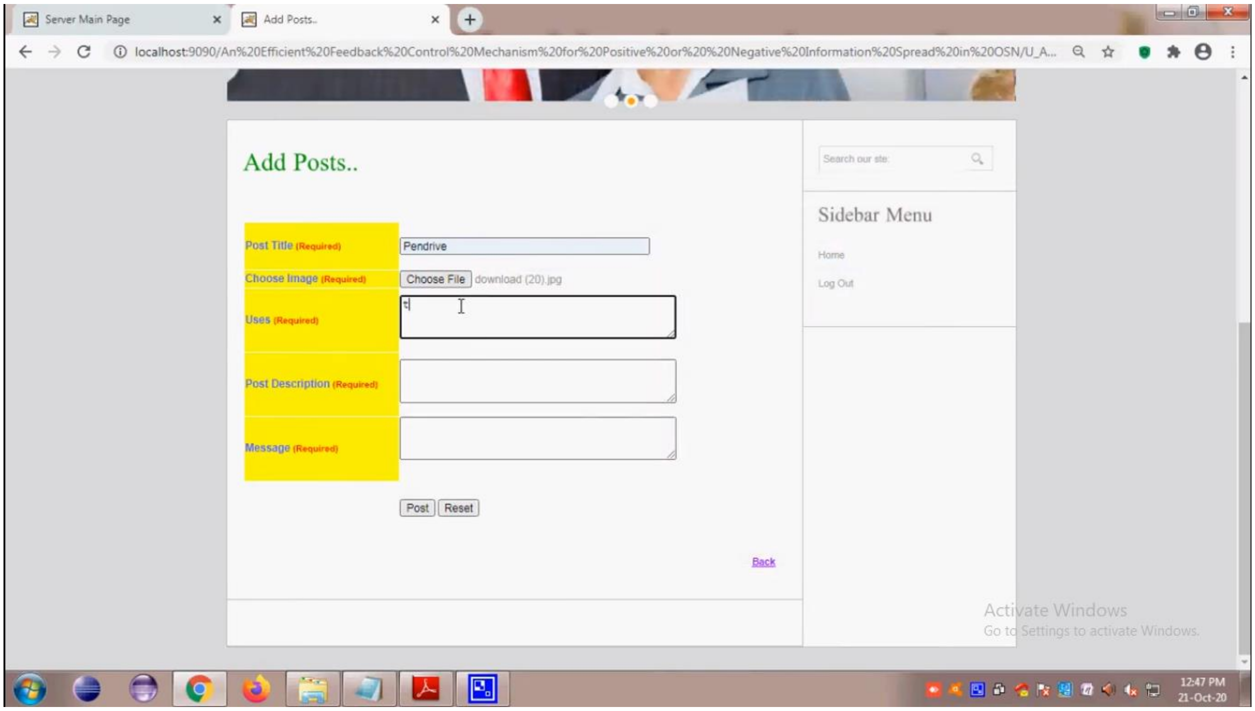

Fig 10. Results screenshot 10

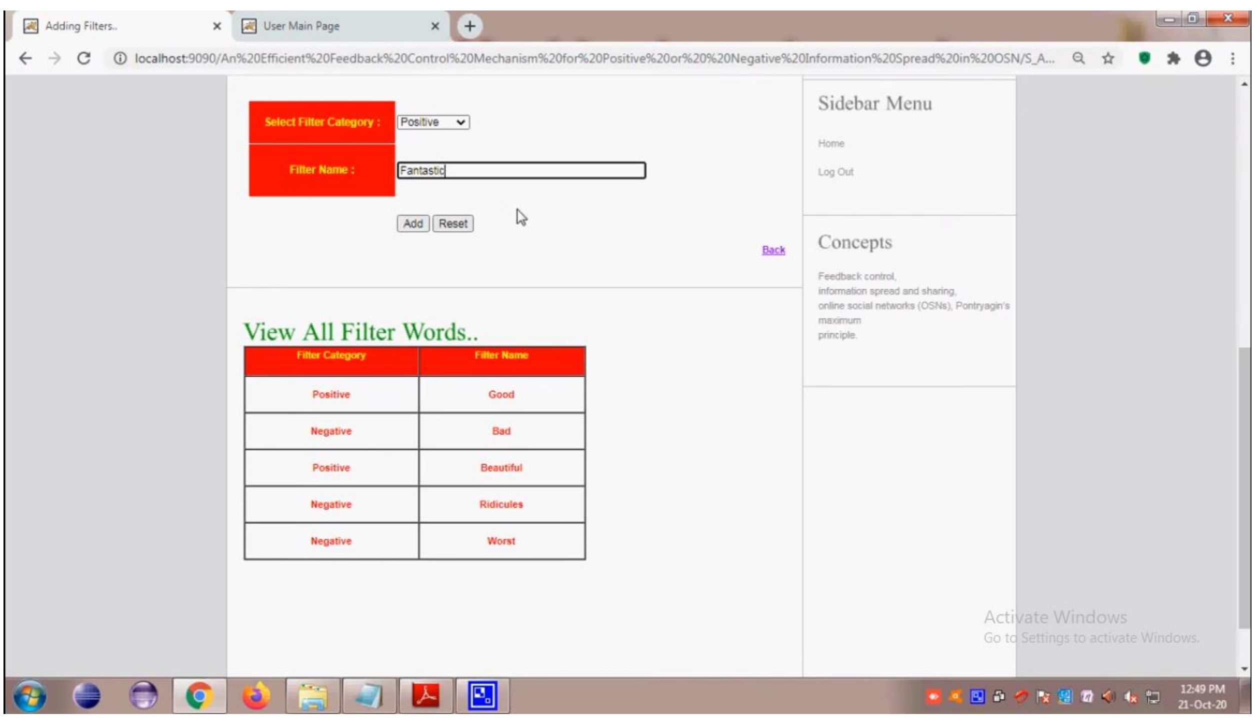

Fig 11. Results screenshot 11

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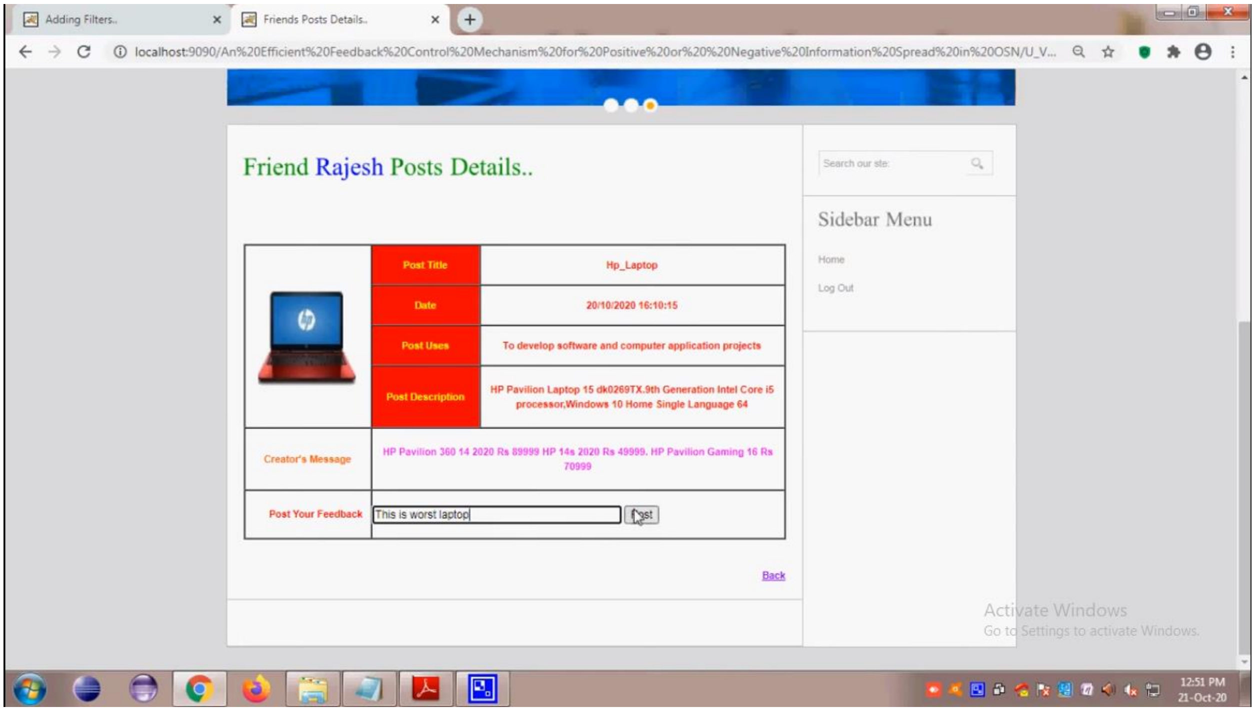

Fig 12. Results screenshot 12

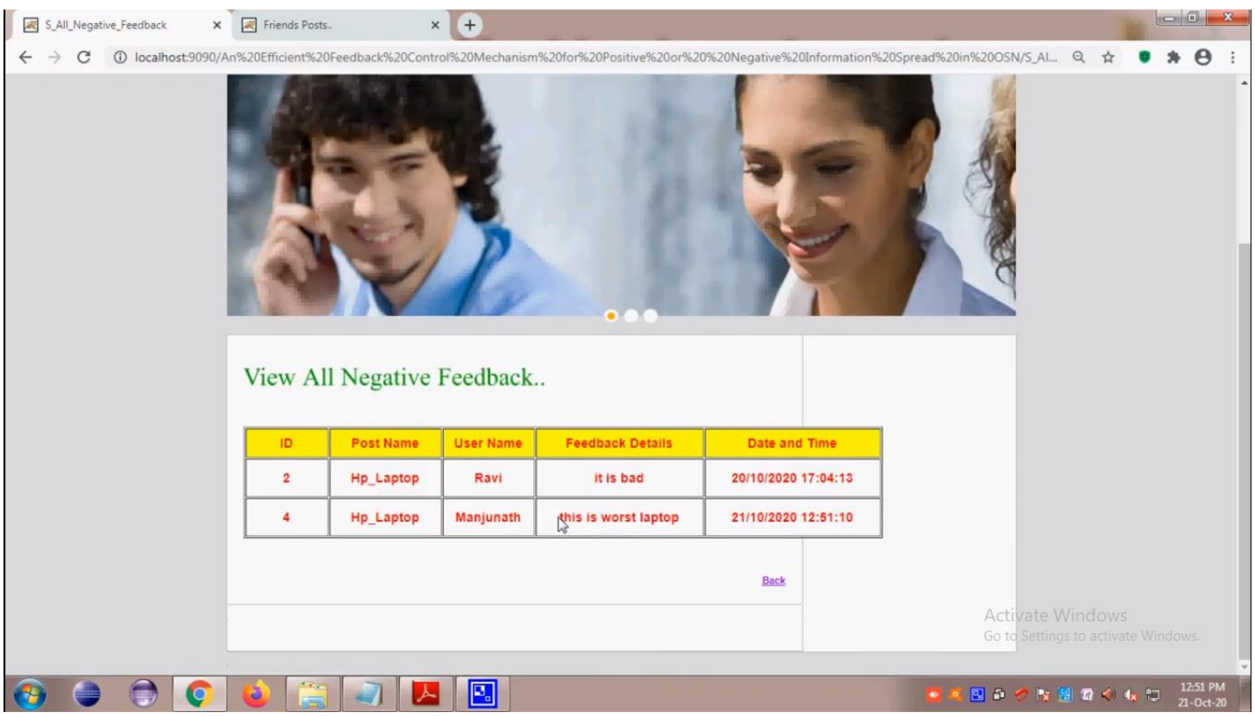

Fig 13. Results screenshot 13

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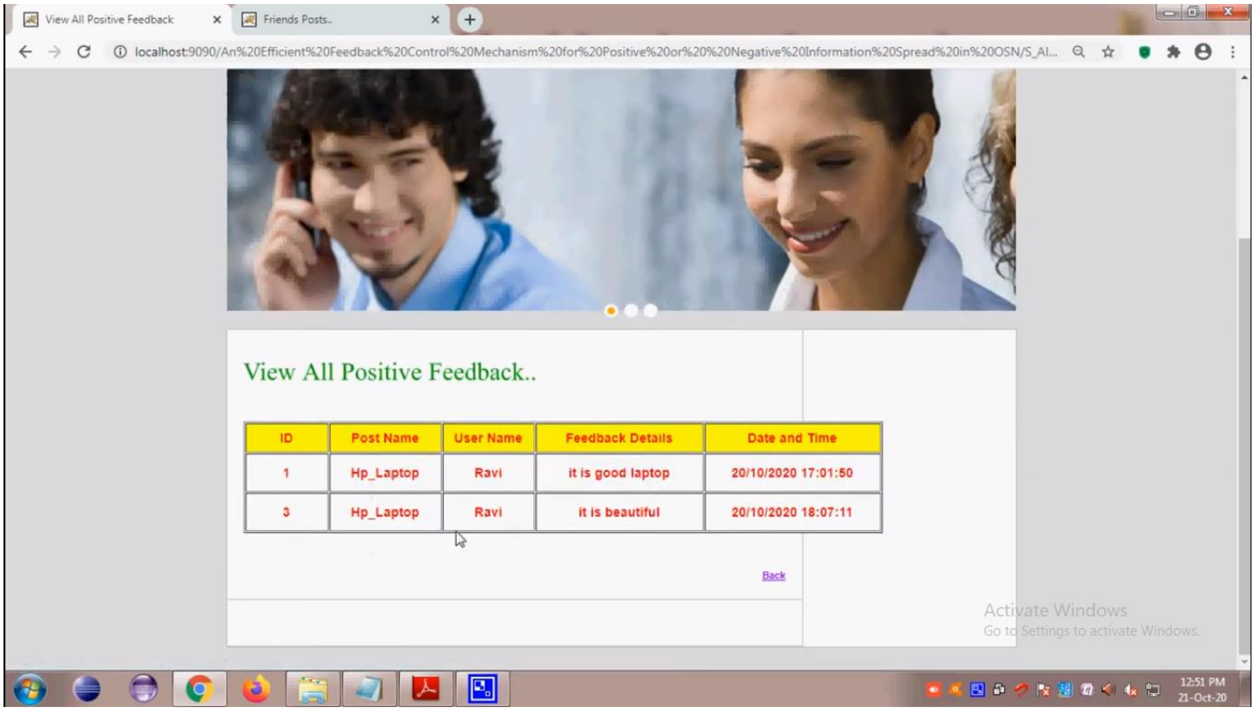

Fig 14. Results screenshot 14

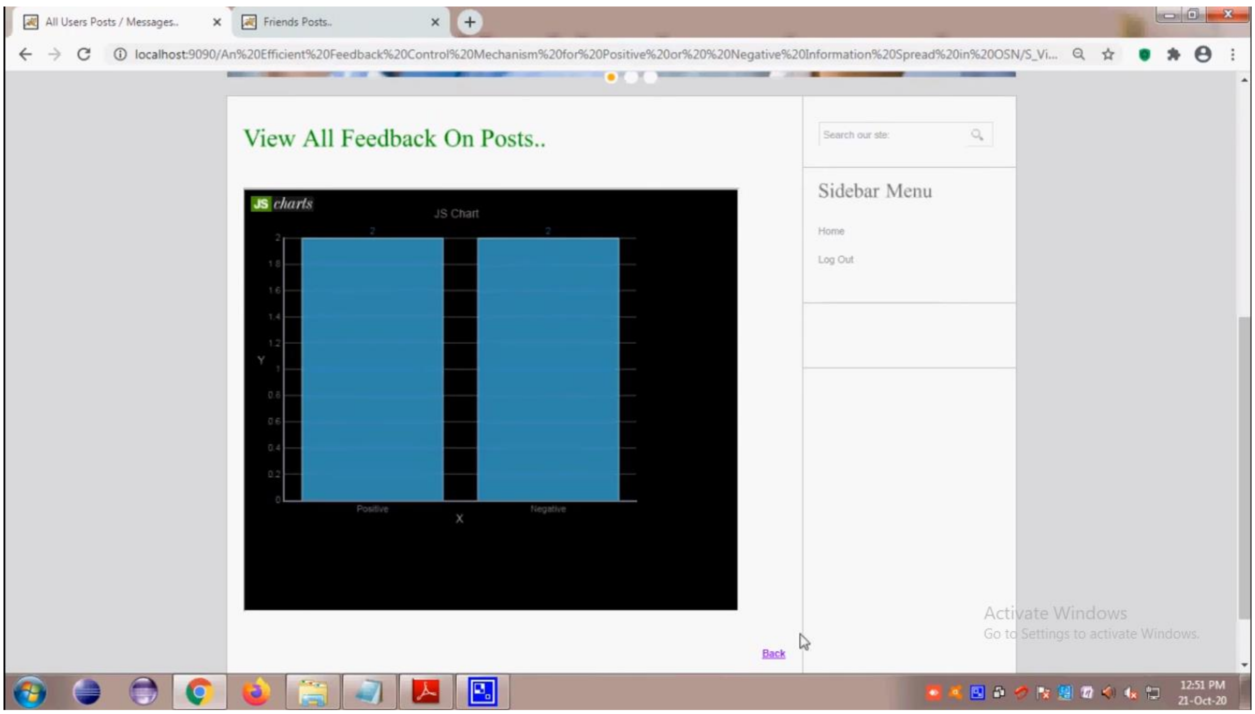

Fig 15. Results screenshot 15

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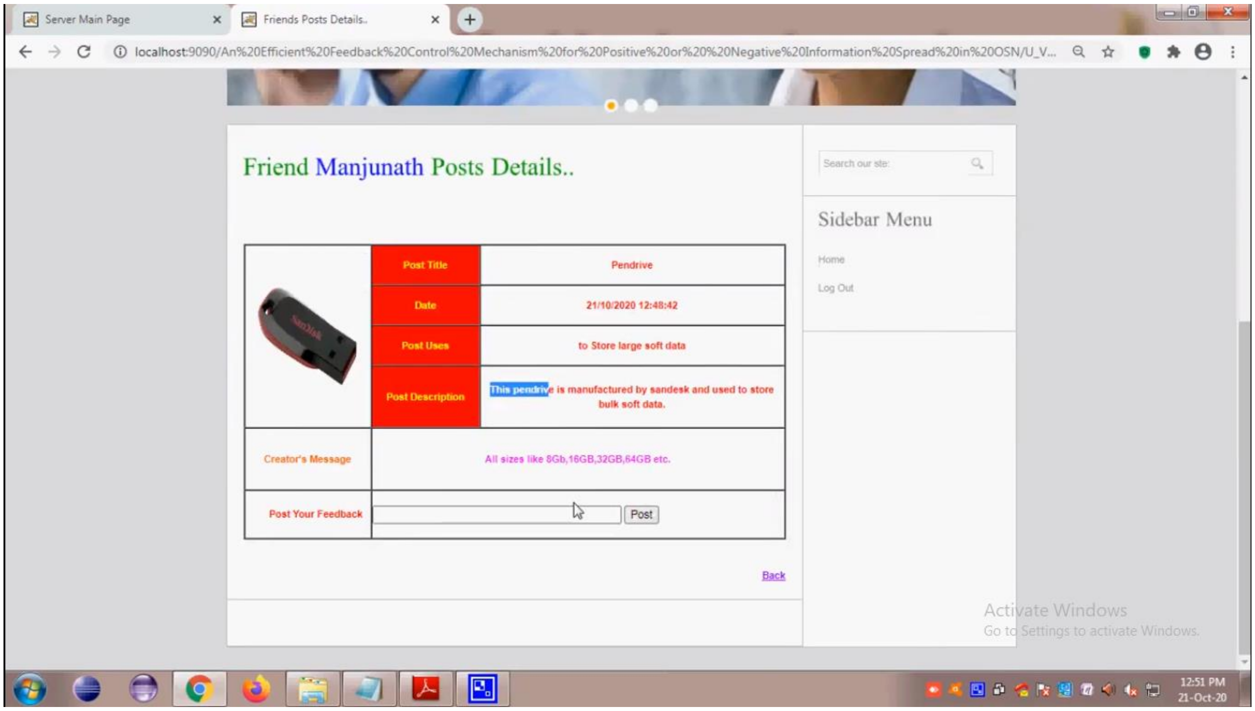

Fig 16. Results screenshot 16

Moreover, the experimental evaluation serves to validate the computational model proposed in the study, demonstrating its ability to accurately capture the temporal dynamics of positive and negative information spread within OSNs. The model serves as a powerful tool for predicting and analyzing information dissemination patterns, providing researchers with valuable insights into the behavior of online social networks and guiding the development of effective control mechanisms. Overall, the experimental results and subsequent discussion underscore the importance of addressing the challenge of managing information spread in OSNs and highlight the potential of the proposed feedback control mechanism as a viable solution to this pressing issue.

CONCLUSION

In conclusion, our proposed feedback control mechanism implemented in Java offers a comprehensive solution for managing the dissemination of positive and negative information in online social networks. By leveraging dynamic adaptation, accurate sentiment analysis, scalability, transparency, and cultural sensitivity, our system addresses the limitations of existing approaches and provides a robust framework for fostering a safer and more constructive online social environment. One of the key strengths of our system is its ability to dynamically adapt to changing information dynamics within online social networks. Through continuous monitoring and real-time adjustment, our system can effectively respond to emerging trends and mitigate the spread of harmful content while promoting positive engagement. The use of Java's event-driven architecture ensures that these adaptations occur swiftly and efficiently, maintaining the system's responsiveness even as network conditions evolve. Accurate sentiment analysis is another crucial aspect of our system. By employing state-of-the-art machine learning algorithms and natural language processing techniques implemented in Java, we can classify the sentiment of content with high precision. This ensures that positive content is not suppressed and negative content is appropriately moderated, fostering a more balanced and

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constructive online social environment. Scalability is a significant advantage of our system, particularly given the vast scale of modern online social networks. With Java's distributed computing capabilities, our system can efficiently handle the immense volume of data generated by millions of users in real-time. By horizontally scaling across multiple servers or nodes, our system can maintain optimal performance even as the size and complexity of social networks continue to grow. Transparency and accountability are fundamental principles guiding the design of our system. By incorporating features such as explainability modules and audit trails into our Java implementation, we provide users and content creators with insights into the decision-making process behind content moderation actions. This transparency enhances user trust and credibility in the system, fostering a more open and accountable online social environment. Cultural sensitivity is another key aspect of our system. By recognizing the diverse cultural and linguistic contexts of online social networks, we ensure that our moderation strategies are adaptable and inclusive. Through Java-based mechanisms for adapting to different cultural norms and languages, our system maintains sensitivity and respect across diverse communities and regions. In conclusion, our proposed feedback control mechanism offers a comprehensive and effective solution for regulating the spread of positive and negative information in online social networks. By leveraging the power of Java's advanced programming capabilities, our system provides a robust framework for fostering a safer, more inclusive, and more constructive online social environment for users worldwide.

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