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Advancements in Web Accessibility and Sentiment Analysis: A Comprehensive Review

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Abstract*—This paper examines recent developments in web accessibility and sentiment analysis, drawing from studies on machine learning, web technologies, database systems, and optimization techniques. Web accessibility ensures that digital platforms are usable by people with disabilities, following standards like WCAG 2.1, which promotes equal access to online resources. Sentiment analysis uses machine learning to understand public opinions from sources such as social media, online reviews, and forums, providing valuable insights for businesses, governments, and communities. By reviewing key research, we identify major challenges, effective methods, and new trends in these fields, focusing on their applications in healthcare, education, and crisis management. We also explore how technologies like NoSQL databases, genetic algorithms, blockchain, and Web 3.0 improve data processing, security, and user experience. This study highlights the connection between accessibility and sentiment analysis, showing how they can work together to create fair and smart digital systems. Our goal is to provide a clear guide for students, researchers, and professionals, offering ideas for future work to build inclusive and data-driven online environments that benefit everyone*

Keywords— Web Accessibility, Sentiment Analysis, Machine Learning, NoSQL Databases, Genetic Algorithms, Blockchain, Web 3.0

1. INTRODUCTION

The internet has become a vital part of daily life, connecting people and sharing information like never before. Web accessibility is essential because it allows individuals with disabilities, such as vision or mobility impairments, to use websites and apps easily, following global standards like WCAG 2.1 [14, 51, 53-55]. Despite improvements, many websites, especially in healthcare and education, still have barriers that exclude users [14, 23, 51]. At the same time, sentiment analysis has grown popular, using machine learning to analyze what people think by studying posts on platforms like Twitter, Amazon, and Flipkart [7, 8, 24, 28, 37, 47, 57]. This helps businesses understand customers, governments track public reactions, and communities respond to crises. Together, accessibility and sentiment analysis are key to making the internet fair, useful, and responsive to everyone's needs.

This paper reviews the latest progress in these areas, based on studies about machine learning, databases, and optimization tools. We look at how machine learning helps check if websites are accessible [23, 46, 53], how NoSQL databases manage large amounts of data [5, 9, 18, 29, 52], and how genetic algorithms make processes faster and better [2, 4, 13, 16, 46]. New technologies like blockchain and Web 3.0 also play a big role by keeping data safe and giving users more control [39, 48, 49]. We aim to answer these questions: What makes it hard to create fully accessible websites? How can sentiment analysis handle huge and varied data? How do new technologies help solve these issues? This paper offers a simple, clear overview for students and others interested in improving digital systems, suggesting ways to make the internet more inclusive and intelligent..

2. WEB ACCESSIBILITY: CHALLENGES AND SOLUTIONS

2.1 Why Web Accessibility Matters

Web accessibility ensures everyone, including people with disabilities, can use digital tools. Research shows that many websites, especially in healthcare and education, don't meet WCAG 2.1 standards [14, 23, 51, 53-55]. For example, Kausar et al. [51] found that hospital websites in Oman often lack features for users with vision or movement issues. Similarly, university websites in India's Delhi NCR region have problems, as shown by machine learning studies [23, 46].

2.2 Using Machine Learning for Accessibility

Machine learning is a great tool for checking website accessibility. Kausar et al. [46] used it to find issues like missing image descriptions and bad color contrasts on university websites. Tools discussed by Sarita et al. [53] make these checks faster, but human reviews are still needed for some problems [55]. Carvalho et al. [55] suggest real-time monitoring to keep up with changing website content.

2.3 Real-World Examples

tudies like the Koha system project [36] show how to improve accessibility for library systems. Healthcare websites also get better with clear accessibility rules, as Arief et al. [54] explain. These examples show that regular checks and global standards are needed to fix accessibility issues.

3. Sentiment Analysis: Methods and Uses

3.1 What is Sentiment Analysis?

Sentiment analysis figures out how people feel by studying text from places like socialize media or online reviews [7, 8, 24, 28, 37, 47]. It's used to analyze Twitter posts during COVID-19 [7, 24] or reviews on Amazon and Flipkart [8, 28, 37, 47]. Tools like Syuzhet [56] and machine learning models [57] make this analysis more accurate.

3.2 Machine Learning in Sentiment Analysis

Machine learning, including deep learning and tools like Latent Dirichlet Allocation [58], makes sentiment analysis better. Nasar et al. [47] used machine learning to study Flipkart reviews, correctly identifying positive, negative, and neutral comments. Kausar et al. [8, 28] did similar work with Amazon reviews, showing how these methods can handle lots of data.

3.3 Sentiment Analysis During Crises

During COVID-19, sentiment analysis of Twitter posts helped understand public feelings and spot false information [7, 24]. This shows how real-time analysis can help with public health. Colneric and Demsar [57] studied emotions on Twitter, proving that mixed models can catch detailed feelings.

4. Databases and Optimization Tools

4.1 SQL vs. NoSQL Databases

Choosing between SQL and NoSQL databases affects how data is stored and used. Kausar et al. [9, 18, 29, 52] compared databases like MongoDB, Cassandra, and Redis, finding that NoSQL is better for messy data in IoT and big data projects [5, 30, 41]. Al Maamari and Nasar [29, 52] showed NoSQL's speed and flexibility for IoT systems.

4.2 Genetic Algorithms for Optimization

Genetic algorithms help make processes like software testing and data searching more efficient [2, 4, 13, 15, 16, 32, 34, 46]. Johri et al. [4, 16] used them to plan testing, reducing errors while saving time. Nasar et al. [2, 46] improved search engines with these methods. These ideas fit with bigger trends in optimization, as Cheng et al. [5, 36] and Eiben and Smith [11, 43] explain.

5. New Technologies: Blockchain and Web 3.0

5.1 Blockchain Uses

Blockchain keeps data safe and clear, which is great for web tools [39, 48]. Kausar and Soosaimanickam [39, 48] studied its use in healthcare and supply chains, showing how it protects user data and supports accessibility.

5.2 Web 3.0 and User Control

Web 3.0, discussed by Nasar [49, 52], uses decentralized systems to give users more power over their data. This helps accessibility by letting users customize interfaces and reduces reliance on big companies, as Herrmann's AI framework suggests [24, 37].

6. Tools and Real-World Uses

6.1 Web Crawlers for Data

Web crawlers collect data for accessibility and sentiment analysis, as Kausar et al. studied [1, 6, 8, 10, 12, 19, 22, 25, 30]. Tools using .NET and mobile agents [4, 17, 19] work faster, and incremental crawling [6, 19] keeps search engines up to date. These are key for real-time data and accessibility checks.

6.2 Data Visualization

Grafana, an open-source tool [59], helps show accessibility and sentiment data clearly. When paired with IoT systems like LoRa [60], it gives real-time insights, like in energy monitoring projects [60].

7. Social and Economic Benefits

7.1 Helping Healthcare and Education

Accessibility and sentiment analysis improve healthcare and education. Accessible websites make it easier for patients to get information, and sentiment analysis of feedback helps hospitals improve [14, 51, 54]. In schools, accessible platforms help students with disabilities, and sentiment analysis of student comments can shape better courses [23, 46]. Saidi et al. [43] show how accessibility supports economies during crises like COVID-19.

7.2 Market Research with Sentiment Analysis

Sentiment analysis helps businesses understand what customers want [8, 28, 37, 47]. Kausar et al. [28] used market basket analysis to find buying patterns, which works well with sentiment studies. These insights help companies create better products and ads, as seen in Amazon and Flipkart studies [8, 37, 47].

8. Ethical Issues and Policy Ideas

8.1 Ethical Problems

Using these technologies can cause issues like data privacy or biased results. Sentiment analysis might miss cultural differences, giving wrong results [7, 24, 57]. Accessibility tools must be truly helpful, not just for show [55]. Blockchain, while safe, uses a lot of energy [39, 48].

8.2 Policy Suggestions

Governments should enforce accessibility rules and support tools like Grafana for monitoring [59]. Offering rewards for using NoSQL databases and blockchain in public projects can spark new ideas [9, 39]. Global teamwork is needed to make sentiment analysis fair and ethical [24, 37].

9. Challenges and Future Steps

9.1 Accessibility Gaps

Many websites in healthcare and education still aren't accessible [14, 23, 51, 53-55]. Future work should focus on automatic checks but include human input for tricky issues [55].

9.2 Scaling Sentiment Analysis

Sentiment analysis struggles with huge, diverse datasets [7, 24, 57]. Combining deep learning with optimization tools [36, 44, 49] could make it more accurate and faster.

9.3 Using New Technologies

Blending blockchain, Web 3.0, and NoSQL databases with accessibility and sentiment analysis needs clear rules [24, 37, 39, 48, 49]. Schools and businesses working together can make these ideas reality faster.

10. Future Scope

The future of web accessibility and sentiment analysis is full of possibilities, with new technologies opening doors to exciting advancements. For web accessibility, researchers can develop smarter tools that automatically fix issues like missing image descriptions or poor color contrasts, reducing the need for manual checks [55]. Artificial intelligence could also create personalized website interfaces that adapt to each user's needs, such as larger text for visually impaired users or voice controls for those with mobility issues [23, 46]. Integrating blockchain could make accessibility audits more transparent by securely tracking compliance data [39, 48].

In sentiment analysis, future work could focus on building models that understand emotions in multiple languages and cultural contexts, making results more accurate for global audiences [7, 24, 57]. Combining sentiment analysis with Web 3.0 could allow users to control their data, ensuring privacy while sharing opinions [49, 52]. NoSQL databases like MongoDB and Cassandra can be optimized to handle even larger datasets, supporting real-time analysis for events like elections or natural disasters [9, 29, 52]. Additionally, genetic algorithms could improve sentiment analysis by finding the best ways to process complex data, saving time and resources [2, 46].

Collaboration between tech companies, universities, and governments will be key to turning these ideas into reality. Open-source platforms like Grafana can be expanded to monitor both accessibility and sentiment trends, helping organizations act quickly [59]. Pilot projects in healthcare and education could test these technologies, creating models for other industries [14, 23, 51]. By focusing on innovation, ethics, and teamwork, the future of these fields can lead to a more inclusive and insightful digital world.

11. Conclusion

This paper reviews progress in web accessibility and sentiment analysis, based on many studies. Tools like machine learning, NoSQL databases, and genetic algorithms are changing how we make digital platforms fair and understand public opinions. New ideas like blockchain and Web 3.0 add exciting possibilities by keeping data safe and giving users more control. However, challenges remain, such as making all websites accessible and handling huge amounts of sentiment data from different languages and cultures. Fixing these issues is crucial for creating digital spaces that everyone can use and benefit from.

Looking ahead, researchers and developers should keep working together to solve these problems. For accessibility, combining automatic tools with human checks can ensure websites meet global standards like WCAG 2.1. For sentiment analysis, building smarter models that understand diverse data will help businesses, governments, and communities make better decisions. Technologies like blockchain and Web 3.0 can support both fields by making systems more secure and user-friendly. By focusing on teamwork, ethical practices, and new tools, we can build a digital world that is fair, smart, and helpful for everyone. This paper hopes to inspire students, researchers, and professionals to keep pushing for these goals, making the internet a better place for all.

12. REFERENCES

[1] Kausar MA, Nasar M, Singh SK. Web crawler: a review. International Journal of Computer Applications. 2013 Feb 15;63(2):31-6.

[2] Nasar M, Johri P, Chanda U. Software testing resource allocation and release time problem: a review. International Journal of Modern Education and Computer Science. 2014 Feb 1;6(2):48.

[3] Kausar MA, Nasar M, Moyaid A. SQL injection detection and prevention techniques in ASP .NET web application. International Journal of Recent Technology and Engineering (IJRTE). 2019 Sep;8(3):7759-66.

[4] Kausar MA, Dhaka VS, Singh SK. Implementation of Parallel Web Crawler through. NET Technology. International Journal of Modern Education and Computer Science. 2014 Aug 1;6(8):59.

[5] S. Cheng, L. Ma, H. Lu, X. Lei, and Y. Shi, "Evolutionary computation for solving search-based data analytics problems," Artificial Intelligence Review, vol. 54, no. 2, pp. 905–947, 2021. [Online]. Available: https://link.springer.com/article/10.1007/s10462-020-09882-x

[6] Nasar M, Johri P, Chanda U. Resource Allocation Policies for Fault Detection and Removal Process. International Journal of Modern Education and Computer Science. 2014 Nov 1;6(11):52.

[7] Kausar MA, Soosaimanickam A, Nasar M. Public sentiment analysis on Twitter data during COVID-19 outbreak. International Journal of Advanced Computer Science and Applications. 2021;12(2).

[8] Kausar MA, Fageeri SO, Soosaimanickam A. Sentiment classification based on machine learning approaches in amazon product reviews. Engineering, Technology & Applied Science Research. 2023 Jun 2;13(3):10849-55.

[9] Kausar MA, Nasar M, Singh SK. Maintaining the repository of search engine freshness using mobile crawler. In2013 Annual International Conference on Emerging Research Areas and 2013 International Conference on Microelectronics, Communications and Renewable Energy 2013 Jun 4 (pp. 1-6). IEEE.

[10] Kausar MA, Dhaka VS, Singh SK. Web crawler based on mobile agent and java aglets. IJ Information Technology and Computer Science. 2013 Sep;5(10):85-91.

[11] A. E. Eiben and J. Smith, "From evolutionary computation to the evolution of things," Nature, vol. 521, pp. 476–482, 2015. [PDF]. Available: https://www.cs.vu.nl/~gusz/papers/2015-From%20evolutionary%20computation%20to%20the%20evolution%20of%20things.pdf

[12] Kausar MA, Nasar M, Soosaimanickam A. A Study of Performance and Comparison of NoSQL Databases: MongoDB, Cassandra, and Redis Using YCSB. Indian Journal of Science and Technology. 2022 Aug 13;15(31):1532-40.

[13] Nasar, Md, Prashant Johri, and Udayan Chanda. "A Differential Evolution Approach for Software Testing Effort Allocation." Journal of Industrial and Intelligent Information Vol 1, no. 2 (2013).

[14] Kausar, Mohammad Abu, Mohammad Nasar, and SALLAM OSMAN FAGEERI. " ACCESSIBILITY GAPS IN OMANI HOSPITAL WEBSITES: A WCAG 2.1 COMPLIANCE STUDY." Journal of Theoretical and Applied Information Technology. ISSN: 1992-8645, Volume 103, No. 6 March 2025, pp 2153-2160.

[15] Nasar M, Johri P. Testing and debugging resource allocation for fault detection and removal process. International Journal of New Computer Architectures and their Applications. 2014 Oct 1(4):193-200.

[16] Johri, P., Nasar, M. and Chanda, U., 2013. A Genetic Algorithm Approach for Optimal Allocation of Software Testing Effort. International Journal of Computer Applications, 68(5), pp.21-25.

[17] Y. Sun, L. Li, Z. Yu, H. Yu, and H. Wang, "Exploring AI models and applications within a system framework," Syst. Res. Behav. Sci., 2024. [Online]. Available: https://onlinelibrary.wiley.com/doi/abs/10.1002/sres.3036

[18] Kausar MA, Nasar M. SQL versus NoSQL databases to assess their appropriateness for big data application. Recent Advances in Computer Science and Communications (Formerly: Recent Patents on Computer Science). 2021 May 1;14(4):1098-108.

[19] Kausar MA, Dhaka VS, Singh SK. An Effective Parallel Web Crawler based on Mobile Agent and Incremental Crawling. Journal of Industrial and Intelligent Information Vol. 2013 Jun;1(2).

[20] Nasar M, Saleem Basha, "Resource Allocation in Cloud History Kerberos based Approach," International Journal of Computer Applications, 2022.

[21] Kausar MA, Nasar M, Singh SK. Information Retrieval using Soft Computing: An Overview. International Journal of Scientific & Engineering Research. 2013 Apr;4(4):388.

[22] Fahdi HS, Kausar MA, Madi NK, Alhasanat AI. Career counseling model for Omani high school students using fuzzy logic. Int. J. Eng. Inf. Syst. 2022;6(1):38-45.

[23] Kausar, M.A., Nasar, M. and Singh, A., 2024. Web accessibility challenges in Delhi NCR region university websites: An in-depth analysis using machine learning. In Artificial Intelligence and Information Technologies (pp. 393-399). CRC Press.

[24] H. Herrmann, "The arcanum of artificial intelligence in enterprise applications: Toward a unified framework," Journal of Engineering and Technology Management, vol. 64, 2022. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0923474822000467

[25] Kausar A, Dhaka VS, Singh SK. A novel web page change detection approach using Sql Server. International Journal of Modern Education and Computer Science. 2015 Sep 1;7(9):36.

[26] Said A. ALMandhari, Emdad S. M., Mohamed Aissa, Mohammad Abu Kausar, "A COMPARATIVE STUDY ON TRADITIONAL VS AGILE," International Journal of Latest Trends in Engineering and Technology, 2020.

[27] Kausar MA, Nasar M. An effective technique for detection and prevention of SQLIA by utilizing CHECKSUM based string matching. International Journal of Scientific & Engineering Research. 2018 Jan;9(1):1177-82.

[28] Kausar MA, Fageeri SO, Soosaimanickam A. MBA: market basket analysis using frequent pattern mining techniques. Int J Recent Innovation Trends Computing Commun. 2023;11:15-21.

[29] Sanda Rashid Salim Al Maamari, Mohammad Nasar A Comparative Analysis of NoSQL and SQL Databases: Performance, Consistency, and Suitability for Modern Applications with a Focus on IoT. (2025). East Journal of Computer Science, 1(2), 10-15. https://doi.org/10.63496/ejcs.Vol1.Iss2.76

[30] Kausar MA, Dhaka VS, Singh SK. Design of web crawler for the client-server technology. Indian Journal of Science and Technology. 2015 Dec;8(36):1-7.

[31] R. E. Bawack and S. Fosso Wamba, "A framework for understanding artificial intelligence research: insights from practice," J. Enterp. Inf. Manag., vol. 34, no. 5, pp. 1339–1361, 2021. [Online]. Available: https://www.emerald.com/insight/content/doi/10.1108/JEIM-07-2020-0284/full/html

[32] Nasar M, Johri P, Chanda U. Dynamic effort allocation problem using genetic algorithm approach. International Journal of Modern Education and Computer Science. 2014 Jun 1;6(6):46.

[33] Kausar MA. Website Assessment and Feature Metrics of University's Website Accessibility: An Evaluation of 15 Top-Ranked Universities of India.

[34] Nasar M, Johri P. Testing Resource Allocation for Modular Software using Genetic Algorithm. IJNCAA. 2015:29.

[35] Nasser Al Musalhi and Mohammad Nasar, " Forecasting Week-Ahead Closing Price of Muscat Securities Market Using Hybrid TCN-LSTM Model." Journal of Theoretical and Applied Information Technology. ISSN: 1992-8645, Volume 103, No. 7 April 2025, pp 2980-2990.

[36] Asma Abdullah Al Abadi, Kausar MA, "Koha System Performance Tuning: A Case Study" International Journal of Engineering and Information Systems, 2024.

[37] Kausar MA, Nasar M, Singh A., 2024. Sentiment classification based on machine learning approaches in flipkart product reviews. In Artificial Intelligence and Information Technologies (pp. 400-406). CRC Press.

[38] X. Chen, Y. S. Ong, and M. H. Lim, "A multi-facet survey on memetic computation," IEEE Trans. Evol. Comput., vol. 15, no. 5, pp. 591–607, 2011. [PDF]. Available: https://memetic-computing.org/publication/journal/Multi-Facet-Survey-%20Memetic-Computation.pdf

[39] A. Kausar, M.A. , Soosaimanickam, Blockchain technology: Emerging trends and applications, Emerging Applications of Blockchain Technology, 2023.

[40] Hossain SM, Fageeri SO, Soosaimanickam A, Kausar MA. Lie Detection Technique using Video from the Ratio of Change in the Appearance. International Journal of Computer Science & Network Security. 2022;22(7):165-70.

[41] Nasar M, Kausar MA. Suitability of influxdb database for iot applications. International Journal of Innovative Technology and Exploring Engineering. 2019 Aug;8(10):1850-7.

[42] Johri P, Nasar M, Das S, Kumar M. Open source software reliability growth models for distributed environment based on component-specific testing-efforts. InProceedings of the Second International Conference on Information and Communication Technology for Competitive Strategies 2016 Mar 4 (pp. 1-9).

[43] Saidi KS, Kausar MA, Elshaiekh NE. The impact of COVID-19 on economic of Oman and Omani customer's behaviour.

[44] Abdallh Mostafa Mohamed Mohamed Menshawy, Mohammad Nasar Optimizing Software Quality: Integrating Test Case Prioritization, Defect Prediction, and Resource Allocation Strategies. (2025). East Journal of Computer Science, 1(2), 16-21.

[45] Y. J. Gong et al., "Distributed evolutionary algorithms and their models: A survey of the state-of-the-art," Applied Soft Computing, vol. 34, pp. 286–300, 2015. [PDF]. Available: https://repository.essex.ac.uk/13796/1/1-s2.0-S1568494615002987-main.pdf

[46] Kausar MA, Nasar M, Singh SK. A detailed study on information retrieval using genetic algorithm. Journal of Industrial and Intelligent Information. 2013 Sep;1(3).

[47] Nasar M, Johri P. Testing resource allocation for fault detection process. InSmart Trends in Information Technology and Computer Communications: First International Conference, SmartCom 2016, Jaipur, India, August 6–7, 2016, Revised Selected Papers 1 2016 (pp. 683-690). Springer Singapore.

[48] H. Li et al., "Nature-inspired optimization algorithms: Unified framework, evaluation, and behavioural parameter optimization," IEEE Access, vol. 8, pp. 87901–87931, 2020. [PDF]. Available: https://ieeexplore.ieee.org/iel7/6287639/8948470/09064786.pdf

[49] S. Liu, Q. Lin, J. Li, and K. C. Tan, "A survey on learnable evolutionary algorithms for scalable multiobjective optimization," IEEE Trans. Evol. Comput., 2023. [PDF]. Available: https://arxiv.org/pdf/2206.11526

[50] Khan MS, Kausar MA, Nawaz SS. Bigdata analytics techniques to obtain valuable knowledge. Indian J. Sci. Technol. 2018 Apr;11:14.

[51] N. Zhong, J. Liu, and Y. Yao, "Web intelligence meets brain informatics," in Web Intelligence Meets Brain Informatics. Springer, 2007. [PDF]. Available: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=7acf71d80de46eb69aa7e718bd1380d2204c7547

[52] Nasar M. 2023. "Web 3.0: A Review and Its Future." International Journal of Computer Applications 185, no. 10: 41–46

[53] K. Sarita, P. Kaur, and S. Kaur, "Accessibility of Healthcare Sites: Evaluation by Automated Tools," in Lecture Notes in Networks and Systems, 2022. doi: 10.1007/978-981-16-5348-3_50.

[54] M. Arief, S. Rissanen, and K. Saranto, "Effectiveness of web accessibility policy implementation in online healthcare information," in Studies in Health Technology and Informatics, 2020. doi: 10.3233/SHTI200334.

[55] L. P. Carvalho, T. Guerreiro, S. Lawson, and K. Montague, "Towards real-time and largescale web accessbility," in ASSETS 2023 - Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility, 2023. doi: 10.1145/3597638.3608403.

[56] Matthew L. Jockers. Syuzhet: Extract Sentiment and Plot Arcs from Text. 2015. Available at: https://github.com/mjockers/syuzhet. Accessed 30 January 2020.

[57] Colneric N, Demsar J. Emotion Recognition on Twitter: Comparative Study and Training a Unison Model. IEEE Trans Affective Comput 2019; :1–1.

[58] David M. Blei, Andrew Y. Ng, Michael I. Jordan. Latent dirichlet allocation. The Journal of Machine Learning Research 2003; 3:9931022.

[59] Grafana Labs. Grafana—The Open Platform for Analytics and Monitoring. Grafana Labs. Available online: https://grafana.com/ (accessed on 12 February 2025).

[60] Ndukwe, C.; Iqbal, M.T.; Khan, J. An Open Source LoRa Based, Low-Cost IoT Platform for Renewable Energy Generation Unit Monitoring and Supervisory Control. J. Energy Power Technol. 2021, 4, 1–25.