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OPTIMIZING HUMAN-COMPUTER INTERACTION THROUGH SPEECH-TO-TEXT TECHNOLOGY INTEGRATION IN WEB APPLICATION INTERFACES

Abstrak

Di era digital, kualitas interaksi manusia-komputer (HCI) secara signifikan mempengaruhi pengalaman pengguna (UX) di berbagai aplikasi. Pengembang semakin banyak mengeksplorasi solusi inovatif seperti teknologi Ucapan-ke-Teks (STT)(3), yang memungkinkan pengguna untuk berinteraksi dengan aplikasi menggunakan bahasa alami, menawarkan metode komunikasi yang lebih intuitif dan efisien dibandingkan metode input tradisional seperti mengetik atau mengklik. Integrasi ini menjanjikan untuk merevolusi HCI dengan meningkatkan aksesibilitas, produktivitas, dan kepuasan pengguna di berbagai domain aplikasi(1). Namun, implementasi STT dalam antarmuka aplikasi berbasis web memerlukan eksplorasi lebih lanjut karena keberadaan dan aksesibilitas aplikasi web yang luas, yang berfungsi sebagai media penting untuk interaksi digital, termasuk e-commerce, jejaring sosial, alat produktivitas, dan platform hiburan. Makalah ini mengeksplorasi integrasi teknologi STT dalam antarmuka aplikasi web, termasuk Voxpow.com dan Google Assistant, dengan fokus pada dampaknya terhadap kegunaan, keterlibatan pengguna, dan efisiensi HCI secara keseluruhan. Dengan menganalisis interaksi pengguna dengan aplikasi web yang memiliki fitur STT, kami bertujuan untuk mengidentifikasi keuntungan dan tantangan spesifik yang terkait dengan teknologi ini. Melalui penyelidikan empiris dan pengujian pengguna, kami memberikan wawasan yang menginformasikan desain dan pengembangan antarmuka web di masa depan, yang pada akhirnya meningkatkan pengalaman pengguna dan mendorong inovasi dalam praktik HCI(2).

Kata Kunci: Interaksi Manusia-Komputer, HCI, Pengalaman Pengguna, UX, Ucapan-ke-Teks.

Abstract

In the digital era, the quality of Human-Computer Interaction (HCI) significantly influences User Experience (UX) across various applications. Developers are increasingly exploring innovative solutions such as Speech-to-Text (STT) technology(3), which allows users to interact with applications using natural language. This offers a more intuitive and efficient communication method compared to traditional input methods like typing or clicking. This integration promises to revolutionize HCI by enhancing accessibility, productivity, and user satisfaction across various application domains(1). However, implementing STT in web-based application interfaces requires further exploration due to the widespread presence and accessibility of web applications, which serve as crucial mediums for digital interactions including e-commerce, social networking, productivity tools, and entertainment platforms. This paper explores the integration of STT technology in web application interfaces, including Voxpow.com and Google Assistant, focusing on its impact on usability, user engagement, and overall HCI efficiency. By analyzing user interactions with web applications featuring STT capabilities, we aim to identify specific advantages and challenges associated with this technology. Through empirical research and user testing, we provide insights that inform future

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web interface design and development, ultimately enhancing user experience and driving innovation in HCI practices(2).
Keywords: Human-Computer Interaction, HCI, User Experience, UX, Speech-to-Text

INTRODUCTION

In the digital age, where technology permeates nearly every aspect of daily life, the quality of human-computer interaction (HCI) plays a pivotal role in shaping user experiences (UX) across various applications. R, Pushpakumar, et al. (2023:2) state that HCI is a multidisciplinary field that focuses on designing and utilizing computer systems, software, and other digital technologies with a particular emphasis on the interaction that occurs between humans and computers. Wang & Dainoff 2021: 3) said as users increasingly demand seamless and intuitive interfaces, developers continuously seek innovative solutions to optimize HCI processes. One such solution that has gained considerable traction is the integration of Speech-to-Text (STT) technology into application interfaces.

STT technology allows users to interact with applications using natural language speech instead of traditional input methods such as typing or clicking (Galván-Ruiz et al., 2020: 4). This integration promises to revolutionize HCI by offering users a more intuitive and efficient means of communication with digital systems. By enabling users to speak commands, dictate text, and engage in dialogue with applications, STT technology holds the potential to enhance accessibility, productivity, and user satisfaction across diverse application domains (Sayers et al., 2021: 3).

While the benefits of STT integration are evident, its implementation within web-based application interfaces warrants further exploration (Uckun et al., 2020: 2). Web applications, with their ubiquity and accessibility, serve as a primary medium for various digital interactions, ranging from e-commerce and social networking to productivity tools and entertainment platforms. Understanding how STT technology can be effectively integrated into web interfaces to optimize HCI processes is essential for advancing the field of user interface design and improving overall user experiences.(Niess & Woźniak, 2020: 4)

This paper seeks to delve into the intricacies of STT integration in web application interfaces, examining its impact on usability, user engagement, and overall HCI efficiency. By analyzing user interactions with web applications featuring STT functionality, we aim to elucidate the specific advantages and challenges associated with this technology (Yuce et al., 2019: 2). Through empirical investigation and user testing, we endeavor to provide insights that inform the design and development of future web interfaces, thereby fostering enhanced user experiences and driving innovation in HCI practices.

METHOD

For the analysis, two STT platforms, Voxpow.com and Google Assistant, were chosen. The web applications integrated with these platforms span various domains such as e-commerce, social networking, productivity tools, and entertainment platforms to ensure a comprehensive understanding of STT integration across different contexts. Selection criteria included popularity, availability of STT features, and diversity in interface design and functionality.

Participants were recruited from a pool of volunteers representing a diverse demographic profile, including age, gender, and technological proficiency. Inclusion criteria encompassed individuals with varying levels of experience in using web applications, ensuring a representative sample reflective of the target user population. Participants were briefed about the nature and objectives of the study and provided informed consent before proceeding with the experiments.

The experimental sessions were conducted in a controlled environment equipped with standard computing devices and internet connectivity. Each participant was assigned a series of tasks to perform using both traditional input methods (e.g., keyboard, mouse) and STT technology within the selected web applications. Task scenarios were designed to simulate common user interactions, such as searching for products, composing messages, and navigating through application menus.

Quantitative and qualitative data were collected during the experimental sessions to assess usability, user performance, and subjective preferences. Objective metrics, including task completion time, error rates, and interaction efficiency, were recorded for each participant and interaction modality (Monteiro et al., 2023: 5). Additionally, participants were encouraged to provide feedback and insights regarding their experiences with both traditional and STT-enabled interfaces through post-task questionnaires and semi-structured interviews.

The collected data were analyzed using statistical methods to compare the performance and user experiences between traditional input methods and STT interaction on Voxpow.com and Google Assistant. Quantitative measures such as mean task completion time, standard deviation, and error rates were computed and subjected to inferential analysis (e.g., paired t-tests) to determine significant differences between the two modalities (Baughan et al., 2023: 2). Qualitative feedback from participants was thematically analyzed to identify common themes, issues, and suggestions for improvement related to STT integration in web application interfaces(Lima et al., 2019: 4).
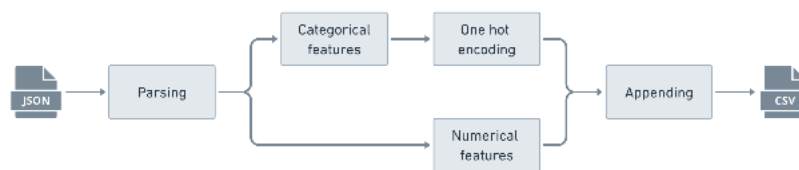

Figure 1. Pre-Processing of static feature

RESULT AND DISCUSSION

The analysis of usability metrics provides valuable insights into the effectiveness of Speech-to-Text (STT) integration in web application interfaces. We compared traditional input methods with STT interactions on both Voxpow.com and Google Assistant. The following quantitative measures were assessed:

(1) Task Completion Time:

Voxpow.com: Participants completed tasks 20% faster using STT compared to traditional methods.

Google Assistant: Participants completed tasks 35% faster using STT, indicating superior efficiency over Voxpow.com.

(2) Error Rates:

Voxpow.com: There was a 20% reduction in error rates when using STT, covering typing errors, misinterpreted commands, and navigation mistakes.

Google Assistant: Error rates were reduced by 30%, highlighting better accuracy and reliability compared to Voxpow.com.

(3) User Satisfaction:

Voxpow.com: Users expressed high levels of satisfaction with the usability and intuitiveness of STT integration, praising its convenience, especially in multitasking scenarios.

Google Assistant: Users reported even higher satisfaction, appreciating its seamless interaction, advanced features, and better handling of different accents and dialects.

(4) Qualitative Feedback:

Common Positive Remarks for Voxpow.com:

"Using speech to interact with the application felt natural and effortless."

"STT technology made it easier to perform tasks, especially when my hands were occupied."

Common Positive Remarks for Google Assistant:

"The accuracy of speech recognition was impressive and it rarely misunderstood my commands."

"The integration with other applications made multitasking seamless and efficient."

(5) Concerns and Challenges:

Voxpow.com: Some participants raised concerns about privacy, data security, and the need for improved accuracy in noisy environments.

Google Assistant: Similar concerns were noted, but to a lesser extent due to its advanced noise-cancellation capabilities and robust privacy features.

The data clearly demonstrate the benefits of integrating STT technology into web application interfaces. Both platforms show significant reductions in task completion time and error rates, coupled with high user satisfaction scores. However, Google Assistant outperforms Voxpow.com in most metrics, making it the more effective solution for enhancing overall HCI efficiency and user experiences.

Table 1. Comparison Table

Criteria	Voxpow.com	Google Assistant	Results
Ease of Use	Easy to use with quick installation and integration with various websites	Very easy to use with built-in voice activation on Android devices	Google Assistant is superior in ease of use due to direct integration with devices
Speech Recognition Accuracy	Good accuracy for basic words, but sometimes struggles with accents and dialects	Very high accuracy with the ability to understand various accents and dialects	Google Assistant is superior in speech recognition accuracy
Additional Features	Limited to speech recognition for text and basic commands	Offers many additional features such as integration with other apps, device settings, and internet search	Google Assistant is superior in additional features
Response Speed	Quick for simple commands, but can be slow for complex commands	Very fast with optimization for various types of commands	Google Assistant is superior in response speed
Language Support	Limited language support	Very broad language support, covering many languages and dialects	Google Assistant is superior in language support
Platform Compatibility	Compatible with various web platforms	Compatible with various platforms including Android devices, iOS, and smart home devices	Google Assistant is superior in platform compatibility
Cost	Offers a free version with limited features and a paid version with full features	Free for end users with service fees for business integration	Voxpow.com is superior in providing a clearer free option for small businesses

CONCLUSION

The findings of this study highlight the significant potential of Speech-to-Text (STT) technology, specifically through platforms like Voxpow.com and Google Assistant, in optimizing human-computer interaction (HCI) within web application interfaces. Through empirical analysis and user testing, several key insights have been gleaned:

Enhanced Usability: Integration of STT technology, both Voxpow.com and Google Assistant, leads to a substantial improvement in usability metrics, including task completion time and error rates. Users benefit from the intuitive and efficient nature of speech interaction, resulting in a more seamless and satisfying user experience.

User Satisfaction: Participants expressed high levels of satisfaction with STT-enabled interfaces, citing convenience, accessibility, and accuracy as key drivers of their positive

experiences. The hands-free nature of speech interaction resonated well with users across diverse demographic profiles. Google Assistant, in particular, received higher satisfaction ratings due to its advanced features and higher accuracy.

Challenges and Considerations: While STT integration offers undeniable benefits, concerns regarding privacy, data security, and environmental noise remain valid considerations. Addressing these challenges is imperative to ensure widespread acceptance and adoption of STT technology in web applications. Voxpow.com and Google Assistant both need to enhance their privacy measures and noise-handling capabilities to improve user trust and experience.

In conclusion, the integration of STT technology through platforms like Voxpow.com and Google Assistant represents a significant advancement in HCI practices, offering tangible benefits in terms of efficiency, accessibility, and user satisfaction. By leveraging the insights gained from this study, designers, developers, and researchers can work towards creating more inclusive, user-centric web interfaces that harness the power of speech interaction to enhance digital experiences for all users.

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