Designing Real-Time Accessible Learning for Visually Impaired Students:

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In the evolving landscape of education, accessibility for students with disabilities, particularly for the visually impaired, remains a critical challenge. Traditional lecture-based teaching, heavily reliant on visual aids like slides and graphs, often marginalizes blind students, limiting their ability to engage fully in classroom activities. Despite the availability of assistive technologies such as screen readers, these solutions often fail in dynamic, fast-paced lecture environments where real-time feedback is crucial. This design science research project addresses this gap by developing an innovative application tailored to enhance the classroom experience for blind students. Drawing from the principles of design science research (Hevner et al., 2004), we aim to create a robust solution that bridges the accessibility divide in real-time learning environments.

Building on existing research on technology for the disabled, particularly in educational contexts (Ellis & Kent, 2017), our application employs advanced deep learning and natural language processing (NLP) techniques to offer a seamless, inclusive classroom experience. The application automatically tracks and processes the professor's presentation slides, providing instant audio descriptions to blind students on their devices. This not only addresses the accessibility issues associated with visual content but also ensures that blind students can participate in lectures alongside their sighted peers without delay.

Visually impaired students often struggle when lecture materials, such as text-heavy slides or complex visual aids like charts and graphs, are presented without immediate accessible alternatives. Our application mitigates this by utilizing convolutional neural networks (CNNs) and recurrent neural networks (RNNs) to detect slide transitions and process visual content in real time. The NLP algorithms then extract meaningful information from the text, while specialized image recognition models interpret and summarize more complex visual elements. The output is delivered through advanced text-to-speech (TTS) technology, ensuring that blind students receive coherent and timely audio descriptions during the lecture.

The underlying architecture of this system is designed for flexibility and scalability, making it adaptable to different subjects, languages, and educational environments. By leveraging deep learning models for real-time content recognition and NLP techniques for audio delivery, the application significantly reduces the latency that typically hampers other assistive technologies. This real-time feedback loop aligns with design science research principles by iterating toward a solution that meets user needs in a practical, scalable manner (Peffers et al., 2007).

This project not only holds transformative potential for enhancing the educational experiences of blind students but also has broader implications for accessibility in education. The core technology can be extended to support students with other disabilities or those in remote learning environments where visual aids are heavily used. The integration of AI-driven models, rooted in the design science paradigm, underscores how technology can be harnessed for social impact by promoting equity and inclusion in the classroom.

In summary, this project embodies a vision of an inclusive educational future, where technology serves as a key enabler of equitable access. By addressing the unique needs of blind students, it contributes to a more inclusive learning environment, ensuring that all students—regardless of their physical abilities—can fully participate and thrive.

References

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