Survey on Assistive Technology and Deep Learning

Abstract

Assistive technologies have seen a transformative evolution through the integration of deep learning, enabling enhanced support for individuals with disabilities. This report surveys recent advancements in assistive technology powered by deep learning, highlighting core techniques, algorithms, current trends, challenges, and prospective solutions.

1. Introduction

Assistive technology (AT) encompasses devices or systems that help individuals with disabilities perform functions that might otherwise be difficult or impossible. Traditional ATs relied on rule-based or static systems, but with the rise of deep learning, these technologies are becoming smarter and more responsive.

2. Deep Learning Techniques in Assistive Technology

2.1 Convolutional Neural Networks (CNNs): Used in image recognition and scene understanding for visual aids.

2.2 Recurrent Neural Networks (RNNs) and LSTM: Applied in speech recognition and gesture recognition.

2.3 Generative Adversarial Networks (GANs): Used for data augmentation and speech enhancement.

2.4 Transformers and Attention Mechanisms: Enable real-time translation, captioning, and assistive NLP tools.

3. Applications

Visual Impairment: Object detection, scene description

Hearing Impairment: STT, real-time captioning

Motor Disabilities: BCIs, predictive keyboards

Cognitive Disabilities: Emotion recognition, learning systems

Elderly Care: Fall detection, monitoring via sensors

4. Trends in Assistive Technology and Deep Learning

Edge AI, Multimodal Learning, Personalized AI, Federated Learning are current trends making AT more efficient and secure.

5. Challenges and Problems

Data Scarcity, Computational Constraints, Accessibility, Ethical Concerns such as privacy and autonomy are major challenges.

6. Solutions and Future Directions

Transfer Learning, Model Compression, Open Datasets, and Human-in-the-loop Systems are potential solutions to address these challenges.

7. Conclusion

Deep learning is transforming assistive technologies. Inclusive, ethical, and collaborative approaches are essential for the future of AT.

8. References

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