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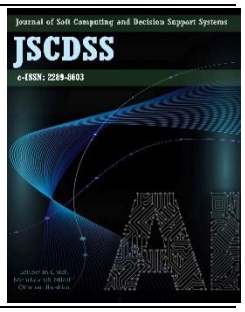

Personalized Text-to-Speech Solutions for Parkinson's Patients through Generative AI

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Abstract

Parkinson's disease significantly impairs speech, leaving patients struggling with reduced vocal clarity, diminished volume, and monotonous tone that hinder effective communication. These challenges often extend beyond physical symptoms, causing social isolation, loss of confidence, and emotional distress. Traditional speech therapies and assistive devices provide some relief but frequently fail to restore the personal and natural qualities of an individual's voice. Generative Artificial Intelligence (GenAI) introduces a new dimension of support by enabling highly personalized text-to-speech (TTS) solutions that replicate or enhance a patient's voice in ways that conventional technologies cannot achieve. This paper explores how GenAI-powered TTS systems can be tailored for Parkinson's patients, examining their role in clinical settings, daily life, and social integration. It discusses the technical foundations of voice cloning, adaptive speech synthesis, and natural language processing while highlighting the medical benefits of improved communication in therapy and consultations. The analysis also addresses the emotional and psychological impact of restoring a patient's unique vocal identity, which strengthens self-esteem and nurtures meaningful human connections. Challenges related to accessibility, ethical considerations, and data security are considered, alongside future directions such as multimodal communication, brain–computer interfaces, and integration with telemedicine. Ultimately, personalized TTS solutions represent more than just technological tools; they are lifelines that empower patients to preserve their dignity, maintain independence, and reconnect with the world. By combining medical insight with technological innovation, GenAI offers a transformative approach to Parkinson's care—restoring not only speech but also the human experience of being heard.

Keywords: Parkinson's Disease, Generative AI, Text-to-Speech, Voice Cloning, Communication Support

1. Introduction

Parkinson's disease is a progressive neurological disorder that significantly affects a person's ability to move, communicate, and perform daily activities [1-5]. Parkinson's disease becomes more common as people age [6], affecting around 1% of the population after age 65 [7]. While tremors and mobility issues are often the most visible symptoms, speech difficulties are one of the most challenging and emotionally distressing consequences of the disease. Patients often experience hypophonia, which is a reduced volume of speech, or dysarthria, which makes speech slurred and unclear. As the disease progresses, many individuals lose the ability to express themselves effectively. This loss of voice not only affects their ability to communicate with family, friends, and healthcare providers, but also deeply impacts their emotional well-being and quality of life. Being unable to speak clearly often leads to social withdrawal, feelings of isolation, and even depression, creating an additional burden on both patients and caregivers.

Traditionally, speech therapy has been the primary method of managing communication difficulties in Parkinson's patients [8]. While such therapy can provide meaningful benefits, it is not always accessible or sufficient to meet the needs of every patient. Some individuals struggle to maintain consistent therapy sessions due to physical limitations, transportation difficulties, or financial challenges. Moreover, speech therapy requires time and continuous effort, yet the degenerative nature of Parkinson's means that speech deterioration may still progress despite intervention. Existing technological aids, such as voice amplifiers or generic text-to-speech systems, provide some assistance, but they often feel artificial, lack emotional depth, and do not reflect the patient's natural voice or personality.

This is where advances in Artificial Intelligence (AI), particularly machine learning [9-17] and Generative AI (GenAI) [18-20], can introduce new possibilities in healthcare for disease diagnosis [2, 21-28] (see Table 1). Machine learning techniques have already been applied to detect subtle speech changes that may serve as early markers of Parkinson's progression, and they are being used to develop adaptive systems that learn and adjust to the patient's changing needs. Deep learning models, for