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Developing A Deep Learning-Friendly Database For Hindi Voice Signals: A Comprehensive Approach

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Abstract: In the fast-evolving world of Artificial Intelligence (AI) and Machine Learning (ML), high-quality datasets are essential for building efficient models, particularly in speech processing. This study explores the creation of a deep learning-compatible database specifically designed for Hindi voice signals. Despite Hindi being spoken by over a billion people, existing voice datasets often lack diversity, quality, and accessibility.

Our research outlines the methodology for collecting, annotating, and processing a large corpus of Hindi voice recordings. Representation is ensured across demographics, accents, and recording conditions. Using strict annotation standards, advanced pre-processing techniques, and a structured database architecture, the dataset is optimized for deep learning applications. The dataset is evaluated for linguistic coverage and tested on Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) tasks, showing significant improvements in performance. This work aims to enrich Hindi speech technology and foster inclusive AI solutions.

***Index Terms* -** Hindi Speech Dataset, Data Pre-processing, Deep Learning, Speech Recognition, Speech Synthesis

I. INTRODUCTION

A. Background

Speech processing plays a critical role in applications such as Automatic Speech Recognition (ASR), Text-to-Speech (TTS) synthesis, and speaker identification. These systems rely on large and diverse datasets to achieve accuracy. However, despite being one of the most widely spoken languages globally, Hindi remains under-resourced in terms of high-quality voice databases. Existing datasets often lack demographic diversity, accent coverage, and standardized annotations, limiting the development of robust Hindi-specific AI applications.

B. Problem Statement

Current Hindi voice datasets suffer from:

1. **Limited Size and Diversity:** Inadequate coverage of linguistic variations, dialects, and accents.
2. **Annotation Inconsistency:** Poorly standardized transcription affects training quality.
3. **Technical Challenges:** Background noise, inconsistent recording quality, and incompatible data formats reduce usability.

These issues necessitate the creation of a high-quality, deep learning-compatible Hindi speech dataset.

C. Objectives

The objectives of this research are to:

1. Create a large-scale, diverse Hindi voice dataset.
2. Ensure compatibility with deep learning frameworks.
3. Improve annotation consistency and quality.
4. Evaluate the dataset's performance on ASR and TTS models.

D. Significance

The dataset aims to enhance:

1. **ASR Systems:** Improving recognition accuracy.
2. **Speech Synthesis:** Enabling natural-sounding synthetic voices.
3. **Language Processing Applications:** Supporting translation, accessibility, and education tools.

II. LITERATURE REVIEW

A. Existing Hindi Voice Datasets

1. **CMU Wilderness Dataset:** Covers multiple languages but lacks Hindi accent diversity.
2. **Mozilla Common Voice:** Crowdsourced but inconsistent in quality.
3. **IIT-KGP Corpus:** High quality yet insufficient in size.
4. **Hindi ASR Corpora:** Fragmented with annotation inconsistencies.

B. Requirements of Deep Learning Speech Datasets

Effective speech datasets must be:

1. **Diverse:** Covering accents, dialects, and age groups.
2. **Accurately Annotated:** With reliable transcriptions.
3. **Well-Formatted:** Compatible with TensorFlow, PyTorch, and other ML frameworks.
4. **Augmented:** Through noise addition, pitch-shifting, and speed variations.

C. Research Gaps

1. Limited demographic representation.
2. Insufficient dataset sizes for deep learning.
3. Inconsistent annotations.
4. Lack of framework compatibility.

III. METHODOLOGY

A. Data Collection

1. Recruited participants across age, gender, and regional backgrounds.
2. Recorded in studio and natural environments using professional equipment.
3. Included both scripted and spontaneous speech.

B. Data Annotation

1. Conducted professional Hindi transcriptions.
2. Collected metadata (age, gender, location, recording conditions).
3. Validated annotations through multi-stage quality control.

C. Data Pre-Processing

1. Applied noise reduction and normalization.
2. Segmented speech into phonemes, words, and sentences.
3. Used data augmentation for robustness.

D. Database Design and Access

1. Structured schema for storage and retrieval.
2. Audio in WAV, metadata in JSON/XML.
3. Privacy protection and ethical compliance ensured.

E. Deep Learning Integration

1. Dataset structured for TensorFlow, PyTorch, and Keras compatibility.
2. API access for researchers and developers.

IV. RESULTS AND DISCUSSION

A. Dataset Evaluation

1. **Coverage:** Wide range of accents and speaking styles captured.
2. **Quality:** Clean, noise-free recordings.
3. **Performance:** Improved ASR and TTS accuracy compared to existing datasets.

B. Challenges

1. Recruiting speakers from underrepresented dialect groups.
2. Maintaining annotation consistency.
3. Adjusting dataset for framework compatibility.

C. Recommendations

1. Expand coverage with informal speech and dialects.
2. Standardize annotation protocols further.
3. Foster community collaboration for dataset updates.

V. CONCLUSION

This research developed a deep learning-friendly Hindi voice dataset addressing major gaps in diversity, annotation quality, and technical compatibility. The dataset improves ASR and TTS models and supports broader applications such as education, accessibility, and language technology.

Future work includes expanding informal speech coverage, refining annotation standards, and engaging the research community for iterative improvements. By ensuring inclusivity and accessibility, this dataset contributes significantly to advancing Hindi speech technology.

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