Towards an AI to Win Ghana's National Science and Math Quiz

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Background

- There is a lack of enough qualified teachers in Sub-Saharan Africa.
- Only 65% of Sub-Saharan Africa teachers have the minimum required skills.
- 15 million more teachers are needed to reach UNESCO goals by 2030.

Motivation and Goal

Motivation: Augment limited number of qualified teachers in Africa by creating an AI teaching assistant for teachers.

Goal: Develop NSMQ AI, an AI to compete live and win in Ghana’s National Science and Math Quiz (NSMQ).

Why NSMQ?

- NSMQ is a live contest that covers Biology, Physics, Chemistry, and Math.
- Provides a robust benchmark for an AI teaching assistant in an African context.

Technical Challenges:

The project involves complex tasks such as speech-to-text, text-to-speech, question-answering, and human-computer interaction.

NSMQ AI Teams: The project has 6 teams that work together collaboratively towards accomplishing the goal: Data Curation, Data Preprocessing, Web App, Speech-to-Text, Question Answering, and Text-to-Speech. Focus on Riddles round for debut in October 2023 ahead of NSMQ 2023.

Data Curation

- Generates Google sheet with links to YouTube / Facebook videos of contests, and relevant information (e.g., year, content, schools competing, total scores of each school, etc.).
- Ongoing efforts to annotate timestamps for clues in each riddle across contests.

Challenges: Insufficient data sources online.

Data Preprocessing

- Focuses on automatic cleaning, transforming, and preparing datasets for the NSMQ AI project.

Major Tasks

1. Automate NSMQ video downloads, delineating start and end of riddles and cropping of riddles.
2. Automate extraction of HTML of resource books and parse into JSON format.

Tech Stack

1. Python
2. Open AI Whisper
3. Google Colab

Web App

Tech stack

1. Front end: Python
2. Back end: FastAPI in Google Colab

Speech-to-Text (STT)

Goal: Provide a robust, fast transcription for Ghanaian-accented English in mathematical and scientific contexts.

Evaluation Metrics

- WER: Measures speech intelligibility.
- MOS: Measures ‘naturalness’ of speech on a scale from 1 (bad) to 5 (excellent).
- Latency: Measures model inference speed.
- User Experience: Measures user satisfaction.
- System Reliability: Measures system’s ability to produce faithful transcriptions.

Text-to-Speech (TTS)

Goal: Develop a TTS system that can synthesize answers from a QA system into audible speech with a Ghanaian accent.

Evaluation Metrics

- WER: Measures speech intelligibility.
- MOS: Measures naturalness of speech on a scale from 1 (bad) to 5 (excellent).
- Latency: Measures model inference speed.
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Next Steps

Data Curation

- Get audio segments of riddles and contest performance for the last 5 years.

Data Preprocessing

- Parse comprehensive corpus of science textbooks.
- Refine HTML extraction validation process.

Web App

- Include live mode with contest stream and AI attempts.
- Make app accessible on cloud.
- Support demo and live quiz modes with media data and user input.

Speech-to-Text

- Automatically detect start of riddle reading.
- Fine-tune model on past NSMQ audio and transcripts.

Question Answering

- Improve model accuracy and latency.
- Generate confidence scores during reading for informed early attempts.

Text-to-Speech

- Enhance scientific and mathematical speech synthesis.