An Equitable ML-based Music Intervention for At-risk Older Adults

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MassAITC AD/ADRD Focus Pilot Core

Introduction

The adoption of digital health interventions has shown promise in reducing cognitive-related health disparities in rural communities.[1] However, rural communities are often underrepresented in the development of digital health tools for cognitive and mental health.[2]

SingFit STUDIO (**Fig.1**), a therapeutic music mHealth app, was developed to increase accessibility to music-based interventions which have been shown to provide many health benefits for individuals with dementia.[3] To ensure SingFit is a culturally relevant tool for better therapeutic acceptability and engagement, **the purpose of this project is to develop an intelligent recommendation system capable of identifying the optimal therapeutic music for rural-residing older adults at-risk for dementia.**

Specific Aims

1. Develop culturally inclusive user personas
2. Design a data-driven recommendation system
3. Assess acceptability of personalized therapeutic music sessions

Expected Outcomes

1. Creation of three distinct user personas
2. 80% improvement in the evaluation metrics using the machine learning (ML) model
3. 85% or higher user acceptability score for recommended songs among rural-residing participants

Design & Methodology

Phase I – Data collection and preprocessing (Table 1)

- 1000 US-based participants, at least 55 years of age with or without an endorsement of known risk factors for dementia
- Participants rate a 5-song "Reduce Depression" playlist on perceived benefit, sentiment, relevance, and preference
- Demographic data and musical preferences were also collected

Phase II –ML Implementation and Evaluation (Figs 2-3)

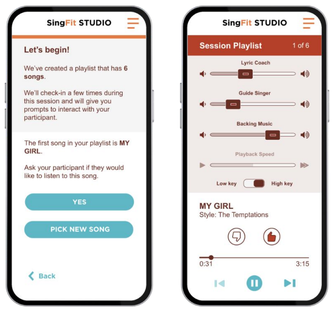
- Development of a Knowledge Graph Embeddings (KGE) model using Phase I data
- 200 new rural-residing participants recruited to test model

Recommendation metrics

- Evaluation: Root Mean Square Error (RMSE) and Normalized Discounted Cumulative Gain (NDCG)
- Acceptability: Group mean score from 5-point ratings on preference, relevance, and benefit of a 5-song playlist

Pilot Project Highlights

Fig 1. The SingFit mHealth App



SingFit STUDIO is specifically designed for older adult health and utilizes expert tailored music algorithms based on an individual's cognitive status, therapeutic goals, and musical preferences. The app provides guided conversation prompts throughout the session for meaning conversations and reminiscence. Lastly, SingFit STUDIO includes an auditory cue prompter and adjustable song tracks.

Table 1. Participants' Characteristics

Characteristic (N = 498)	*n*
Mean Age (*SD*)	62.69 (*6.25*)
Race	
White	406
Black or African American	59
American Indian / Alaskan Native	4
More than one race	11
Prefer Not To Say	2
Ethnicity	
Not Hispanic or Latino	468
Hispanic or Latino	25
Prefer Not To Say	5
Sex	
Female	303
Male	193
Prefer Not To Say	2
Education	
< HS Diploma	13
HS Diploma or equivalent	98
Professional Certification	41
Associate	80
Bachelor's degree	147
Master's degree	92
Doctorate	25
Prefer Not To Say	2
Residence	
Rural	105
Suburban	270
Urban	123

Fig 2. Architecture & Data Flow

The ML development process (below) involves data preparation, configurable experiments to train the model, and building the initial recommender prototype for further testing and refinement.

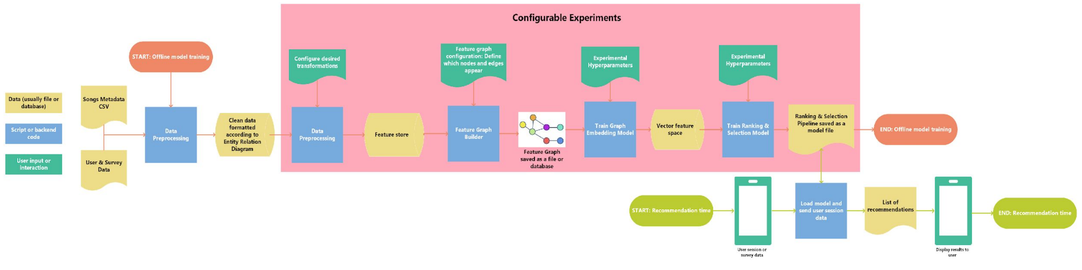
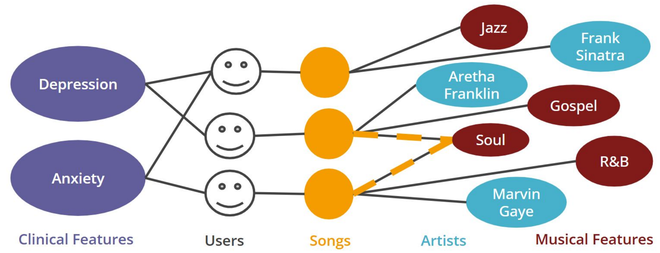


Fig 3. Knowledge Graph Embeddings (KGE)



KGE is a machine learning technique that uses vector representations of entities (e.g., songs) and relationships (e.g., similar genres) in a knowledge graph to capture their meaning and predict related information (e.g., song recommender).

Implications

Despite the promise of digital health tools, there are still significant challenges that are often overlooked regarding their relevance to distinct contexts such as underserved, rural areas. Results from this project will help us to:

- Understand rural users' engagement needs and preferences
- Support at-risk older adults in rural communities seeking ways to reduce dementia risk
- Minimize psychosocial and environmental barriers to engagement

Scan the QR Code to learn more about the Pilot.

References

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