Automatic Anxiety Screening in Pregnant Women from Naturalistic Conversational Speech

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Vocal features can be used as a non-invasive digital biomarker to screen anxiety and stress in pregnant women

Background

Anxiety during pregnancy presents diagnostic challenges, especially in low-resource settings. Speech carries acoustic markers of emotional states, offering a non-invasive alternative for screening. This study explores vocal features and demographics to predict GAD-2 and PSS scores. Results suggest **voice-based models** are promising for early **anxiety screening in pregnant women**.

Methods

Audio data was collected from **88 pregnant women** and segmented into 8s frames. MFCCs, PyAudio, and eGeMAPS features were extracted, and combined with preprocessed demographic data. Models were trained using **GAD-2** and **PSS** scores as labels, evaluated using **Leave-One-Out** cross-validation and standard metrics (AUC, F1, precision, recall, accuracy).

Conclusion

This study found stronger vocal associations with anxiety than with stress in pregnant women. Despite limited performance from classical models, the approach is reproducible, scalable, and computationally inexpensive. Future work may explore deep learning (e.g., Wav2Vec 2.0) and larger datasets for better generalization.

Results

Models trained with GAD-2 showed greater discriminative power, outperforming those using PSS and indicating a stronger association between voice and anxiety.

Figure 1 - AUC-ROC curves using PyAudio + demographics with GAD-2 scores as label.
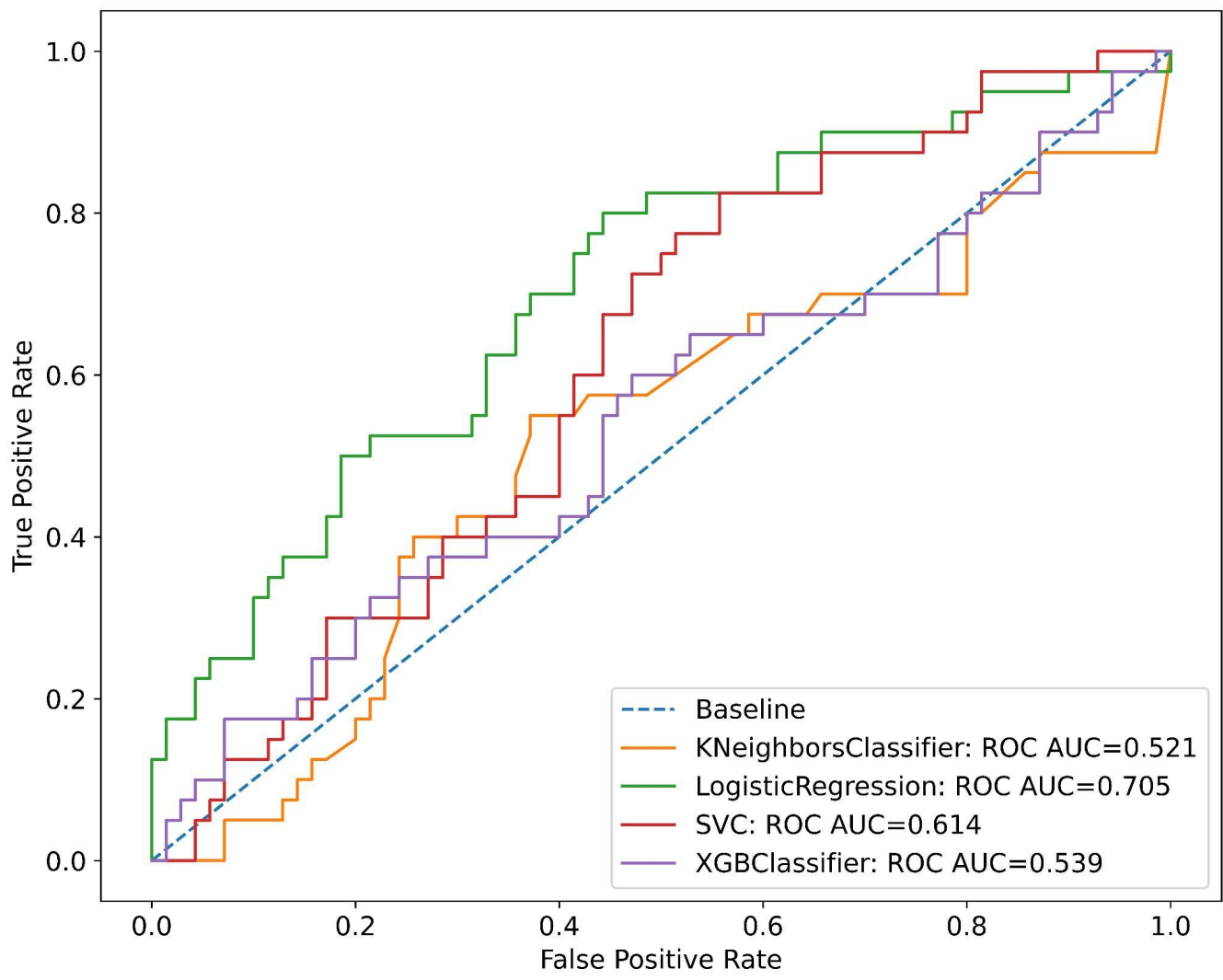
Figure 2 - AUC-ROC curves using PyAudio + demographics with PSS scores as label.
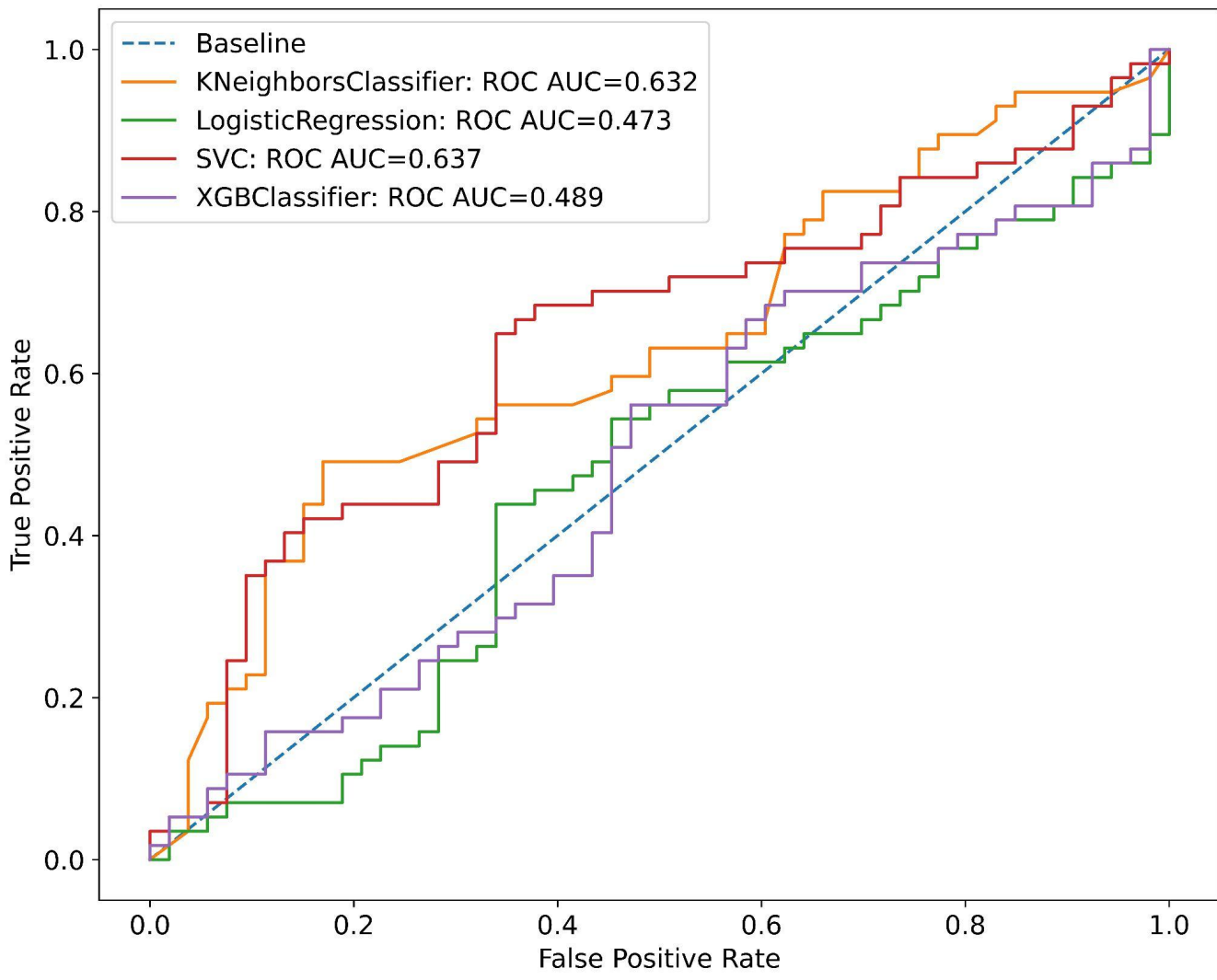

Table 1 - AUC and F1 scores with GAD-2.

Model	LGBM		XGBoost		KNN		Log. Reg		SVC	
Feature Set	AUC	F1	AUC	F1	AUC	F1	AUC	F1	AUC	F1
MFCC	0.52	0.31	0.55	0.36	0.52	0.33	**0.63**	**0.55**	0.60	0.47
PyAudio	0.51	0.29	0.54	0.34	0.52	0.25	**0.70**	**0.51**	0.61	0.35
OpenSmile	0.53	0.37	0.57	0.40	0.58	0.43	0.62	0.47	0.43	0.48

Tabela 2 - AUC and F1 scores with PSS.

Model	LGBM		XGBoost		KNN		Log. Reg		SVC	
Feature Set	AUC	F1	AUC	F1	AUC	F1	AUC	F1	AUC	F1
MFCC	0.60	0.63	0.55	0.57	**0.62**	**0.61**	0.47	0.51	0.56	0.53
PyAudio	0.49	0.55	0.49	0.54	**0.63**	**0.58**	0.47	0.52	**0.64**	**0.65**
OpenSmile	0.59	0.62	0.53	0.51	0.48	0.46	0.50	0.52	0.55	0.58

Patient demographic data is crucial for improving model accuracy.

- Age, marital status, educational level, importance of religion, number of pregnancies, abortions, births, and children

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