BIRZEIT UNIVERSITY

Faculty of Engineering and Technology

Electrical and Computer Engineering Department

ENCS4310, DIGITAL SIGNAL PROCESSING (DSP)

Gender detector, MATLAB Assignment

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Section: 1

Date:

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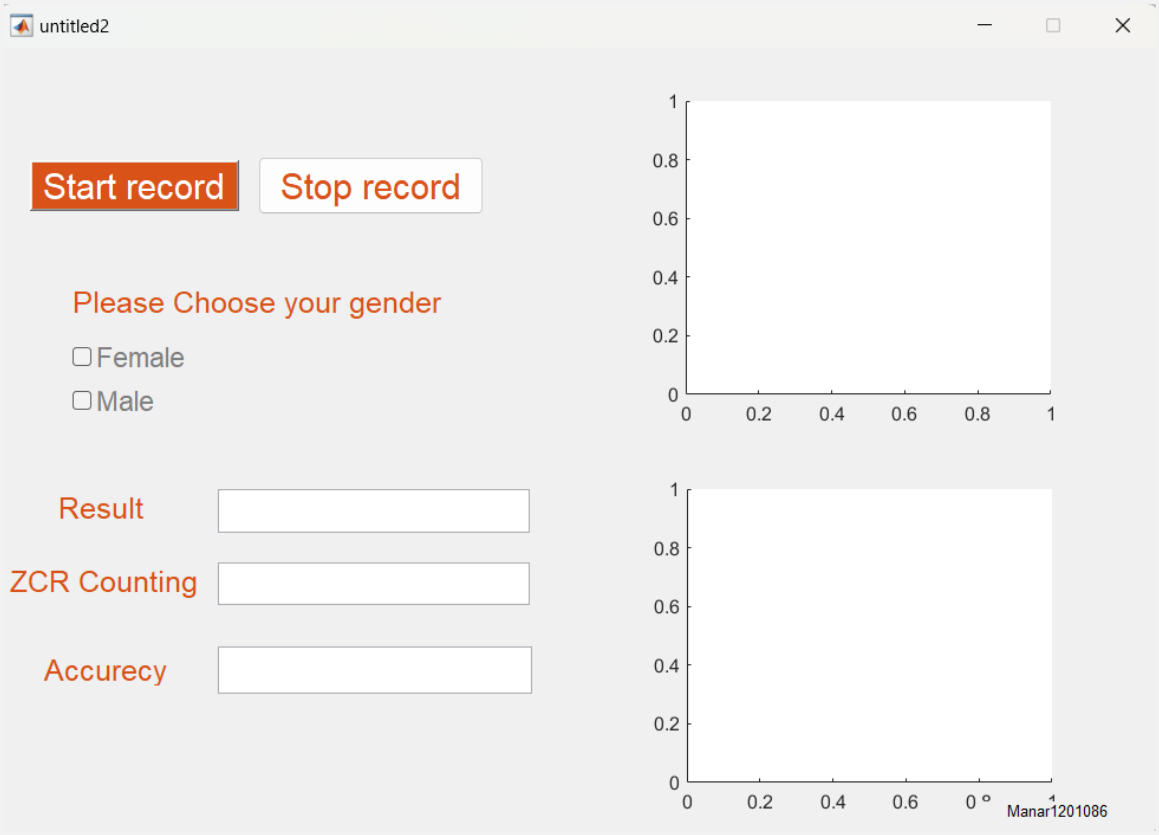
Introduction

- I wrote a MATLAB program that aims to detect the gender of individuals based on features extracted from audio signals using signal processing techniques. The key features: zero-crossing rate, energy, correlation, and power spectral density are computed from both male and female training audio files. And these features are utilized to train a model for gender classification. After that, the system is tested on new separate sets of male and female audio files, and the accuracy of gender classification is evaluated.

- I made also a GUI to interact with users, so they can record their voices and test.



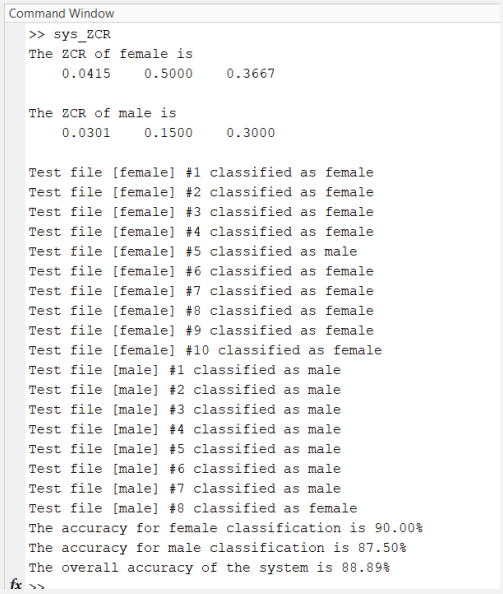
About testing data

The testing data for this project was recorded from a variety of sources and ages, ensuring a diverse range of voice pitches and tones to simulate real-world conditions. The data was split into male and female voices and further divided into training and testing sets. The system performed in classifying the gender based on the audio files and it utilized features such as Zero Crossing Rate (ZCR), energy, correlation, and power spectral density to make accurate predictions. The system demonstrated robust performance with high accuracy rates, although there were misclassifications, particularly in cases where the voice characteristics did not conform to typical gender-based distinctions.

The performance

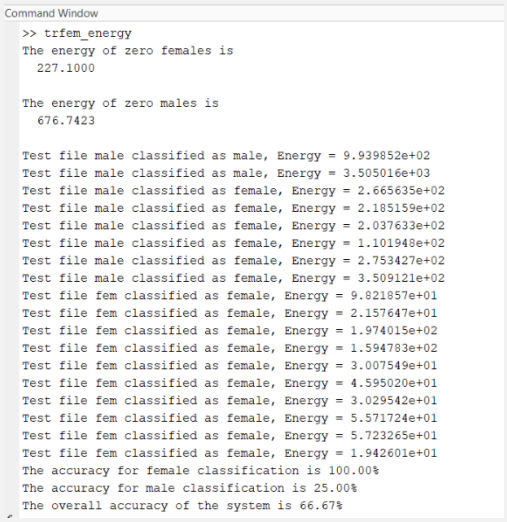
- Results when using **ZCR**:

The ZCR-based gender classification results demonstrate high accuracy “88.89%”, with 90% correct identification for females and 87.5% for males. Notably, the system accurately classified the majority of female test files, showcasing its effectiveness in leveraging ZCR features for gender detection.



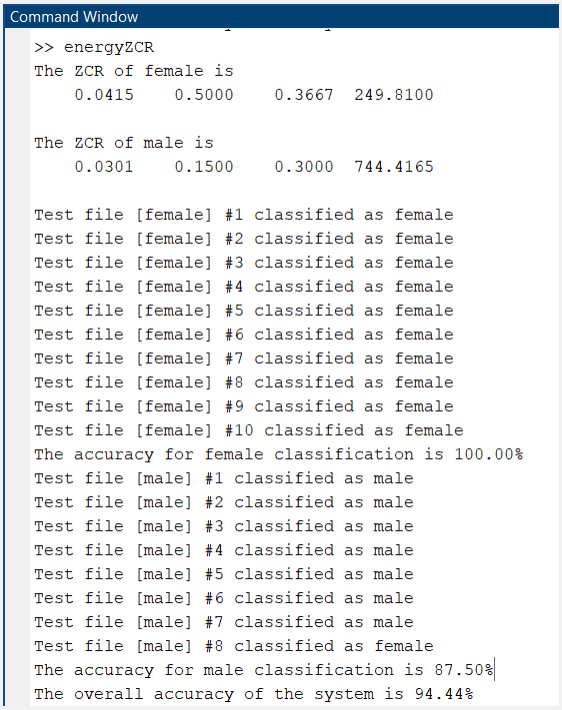
- Results when using **Energy**:

I noticed that when tested, our system was able to classify female voices with 100% accuracy. However, the system’s performance was less robust when classifying male voices, with an accuracy of just 25%. This results that while energy is a useful feature, it may not be sufficient on its own for reliable voice gender classification, particularly for male voices.



- Results when using **ZCR and Energy**:

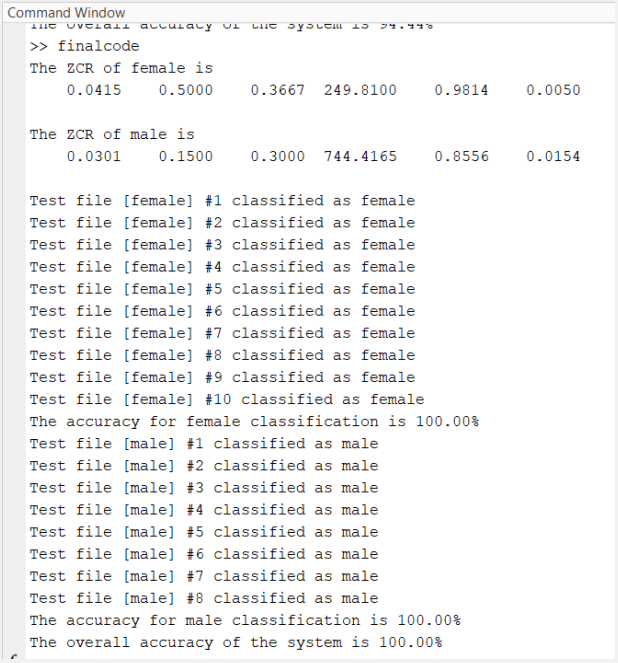
I expanded the feature set for voice gender classification to include both Zero Crossing Rate (ZCR) and energy. This combination of features improved the performance of system. The overall accuracy increased to 94.44%, with perfect classification for female voices and 87.50% accuracy for male voices. This demonstrates the effectiveness of using multiple features for voice gender classification, as it allows the system to capture more complex patterns in the data.



I see that further improvements could be achieved by exploring additional features.

- Results when using **ZCR, Energy, Correlation and pxx**:

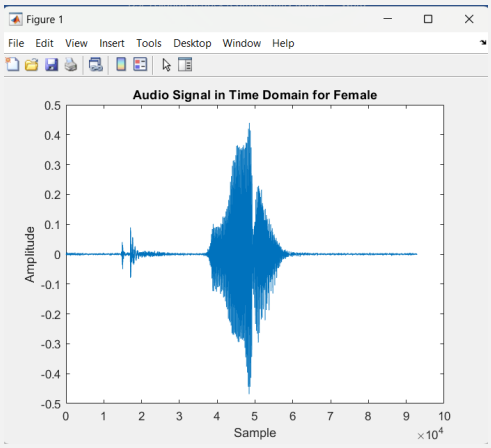
Here, I expanded the feature set for voice gender classification to include Zero Crossing Rate (ZCR), energy, power spectral density (pxx), and correlation. This comprehensive feature set led to a significant improvement in the performance of our system. As shown, the system achieved a perfect classification accuracy of 100% for both female and male voices.

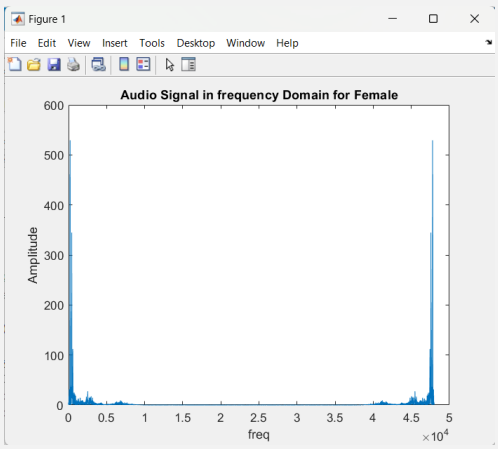


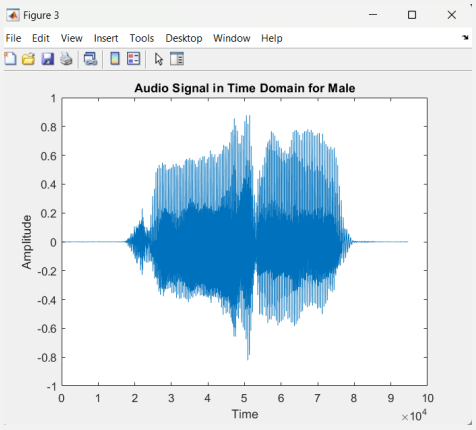
- This underscores the effectiveness of using a diverse set of features that capture different aspects of the audio signal for voice gender classification. The results

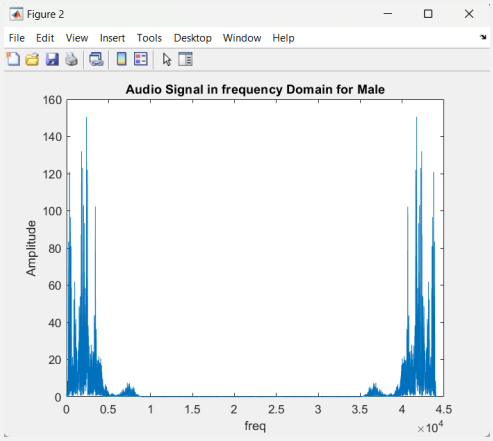
suggest that the combination of these features provides a robust representation of the gender characteristics in voices, leading to highly accurate classification.

- **Plots**:



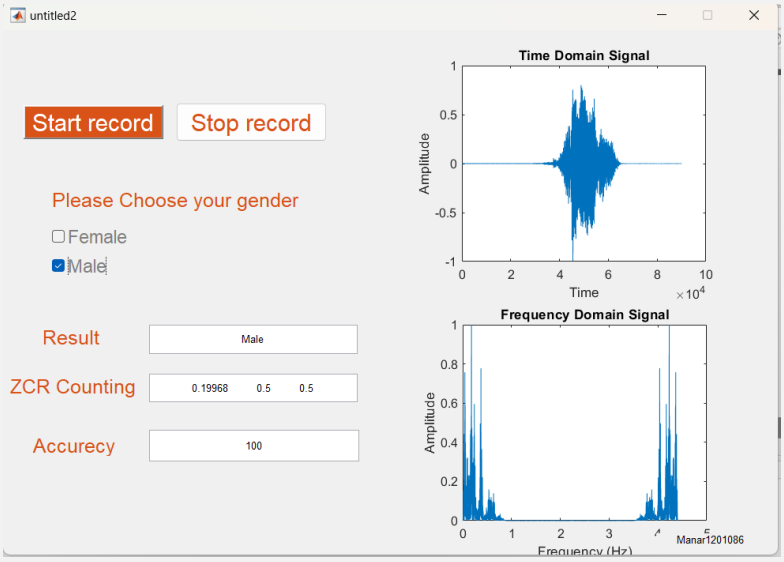






- **GUI**

I noticed here that the mic should be so clear and close when do testing from user, and as shown below TWO users tried the GUI and worked correctly!!



Conclusion

While the system has shown good results, there are several ways it could be improved and extended. Firstly, incorporating additional acoustic features such as pitch, formants, and spectral features could provide a more comprehensive representation of voice characteristics. Advanced machine learning models, particularly deep learning architectures like convolutional neural networks (CNNs) or recurrent neural networks (RNNs), could be employed to learn complex patterns within the audio data, potentially improving performance across diverse voices and speaking styles. The system could also be expanded to handle various words, languages and accents, making it globally applicable. This would involve incorporating multiple datasets during training and developing strategies to accommodate variations in pronunciation and linguistic patterns.

- I make a .exe file for my GUI to make it easier,

U can find it here:

\matlab assign\GenderDetector\for_redistribution_files_only

- Run this and u can test it.