Sound classification

CASE STUDY FOR IMAGIMOB

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Problem 1

We live in a noisy world. Picking out a specific sound, like a cough, from all that noise is tough. But it's essential, especially when we're using technology to help keep us healthy or make our lives easier.

2

Problem 2

Think of an app that's trying to track if you're sick. If it keeps getting it wrong because it mistakes other sounds for a cough, you might miss out on getting the care you need.

3

Problem 3

The real task here is teaching our tech to know the difference between sounds. It's not just hearing a noise; it's figuring out what that noise is, like telling apart a cough from a door squeak.

1

Solution 1

Use mathematical topology to be future-proof (sound has a shape!)

2

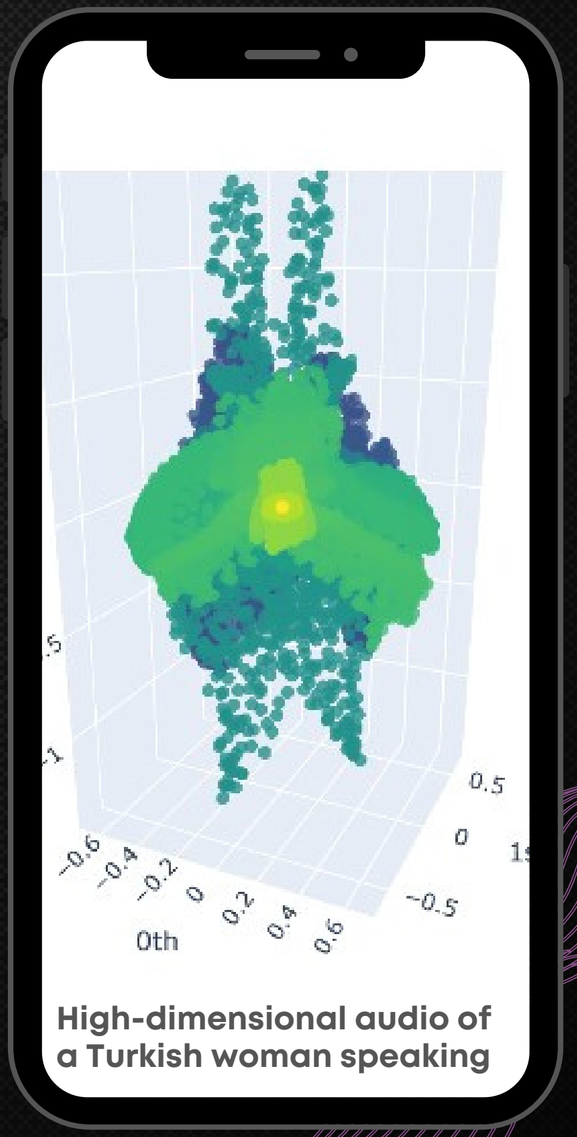
Solution 2

Deliver deep learning models that can distinguish noise from sound

3

Solution 3

Provide insight into the future with topological signal processing

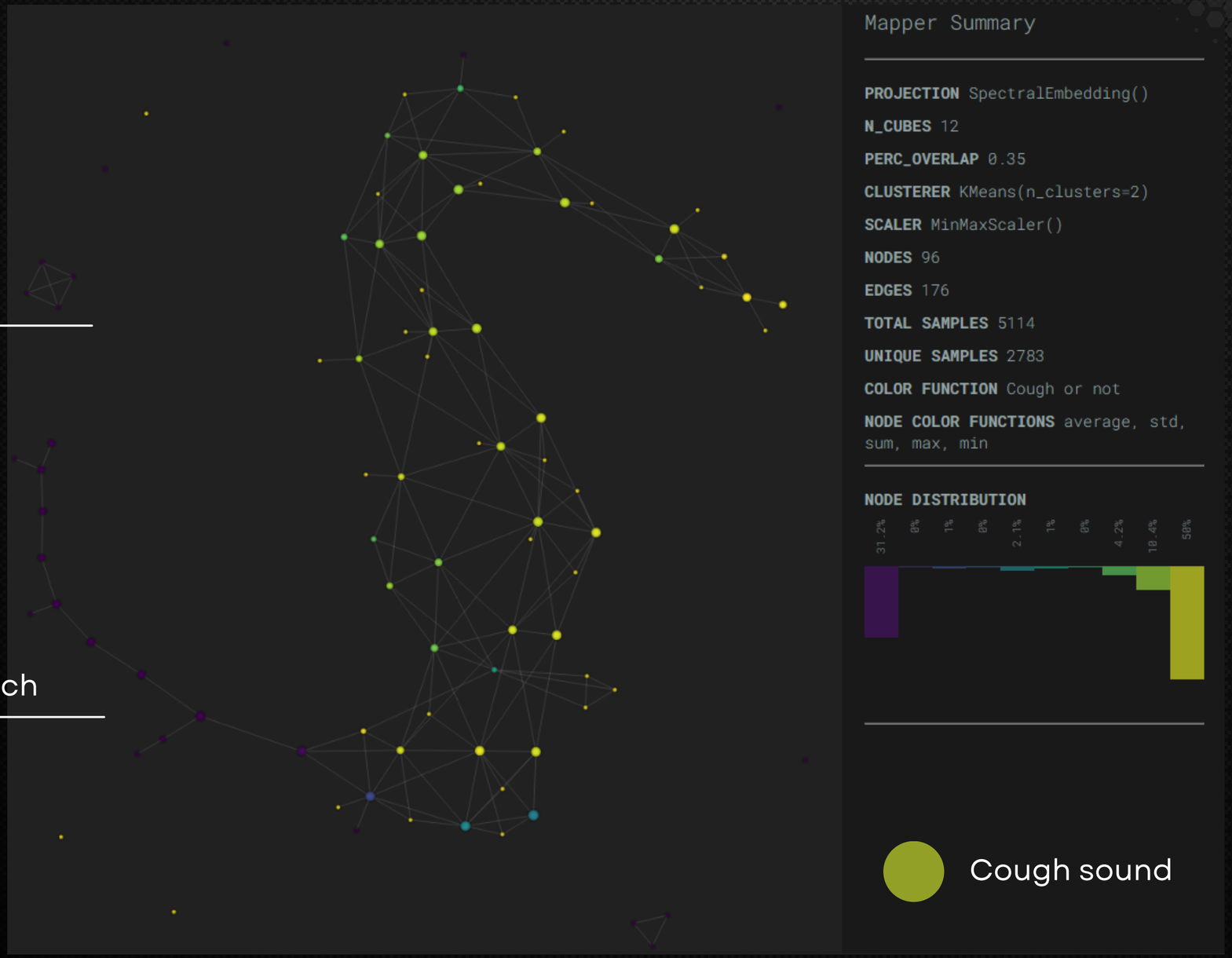


High-dimensional audio of a Turkish woman speaking

Topological signal processing

Animal sound

Human-speech



Mapper Summary

PROJECTION SpectralEmbedding()
N_CUBES 12
PERC_OVERLAP 0.35
CLUSTERER KMeans(n_clusters=2)
SCALER MinMaxScaler()
NODES 96
EDGES 176
TOTAL SAMPLES 5114
UNIQUE SAMPLES 2783
COLOR FUNCTION Cough or not
NODE COLOR FUNCTIONS average, std, sum, max, min

NODE DISTRIBUTION

Cough sound

Cough sound has a large variation between humans

Conceivable difference in men, women, and children

Can theoretically see the shape and tell if it is a child or not

Shape of a cough

Edge devices, IoT, and tinyML services have not yet realized the future beyond deep learning and modern A.I solutions. With this solution, we can provide not only classification of a cough sound but also what it looks like!

Classifying a cough sound

The deep learning models range from 2D-CNN using noisy Mel Spectrograms to hybrid models with 17 million parameters. The noise has been injected to augment the data and make the model robust.

STEP 1

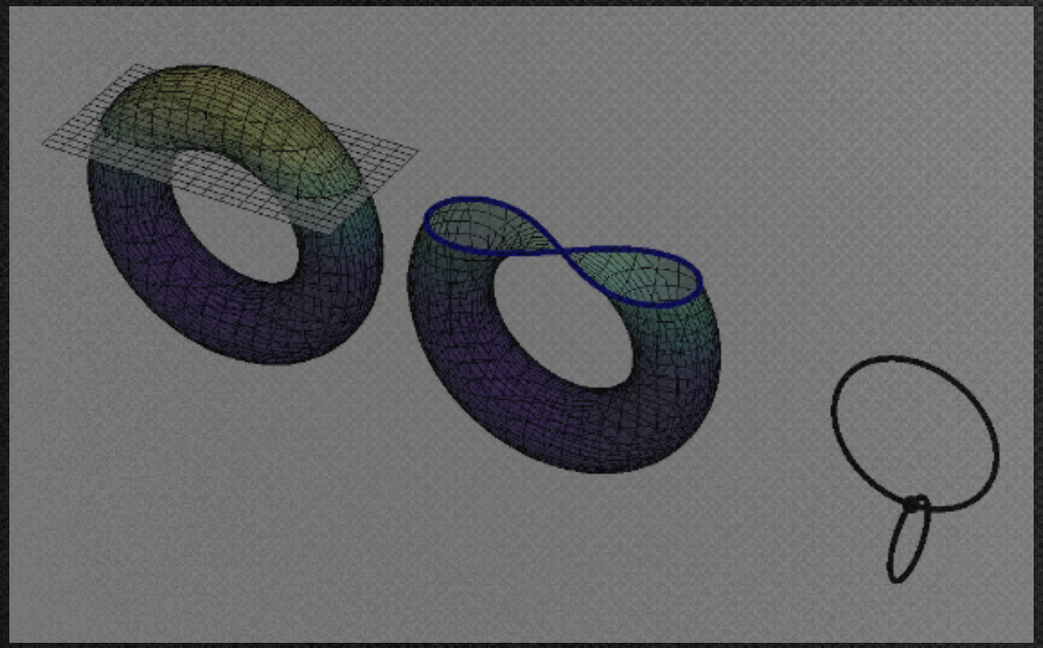
Collect, label, and split data

STEP 2

Preprocess, train, and evaluate

STEP 3

Classify



Traction

What can be done? Seems like topology preprocessing provides alot of information which can’t be found in classical spectrograms.

Hybrid CNN with topology

Advantage 1

Data deformation will not affect the topological features. Bend it, stretch it, topology will still learn from it.

Advantage 2

Finds significant features over a range of scales. Makes it a good tool to find noise in the data.

Advantage 3

Works on raw data - no feature engineering required.

Advantage 4

Robust against noise compared to classical machine learning.

Thank You

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