HeartBeat Anomaly Detection

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Problem Statement

- To detect the abnormalities in the heartbeat
- Classify the abnormal heartbeat into abnormal categories

    -> Artifact

    -> Extrasystole

    -> Extra Heart Sound

    -> Murmur

Dataset

- This is a public Dataset, taken from kaggle .
- The data was gathered from two sources: (A) from the general public via the iStethoscope Pro iPhone app, and (B) from a clinic trial in hospitals using the digital stethoscope DigiScope.
- The dataset is split into two sources, **A** and **B**:

  -> set_a.csv - Labels and metadata for heart beats collected from the general public via an iPhone app

  -> set_b.csv - Labels and metadata for heart beats collected from a clinical trial in hospitals using a digital stethoscope
- **audio files** - Varying lengths, between 1 second and 10 seconds of the 'lub' and 'dub' of the heartbeat and stored in .wav format.
- Dataset is biased towards normal.
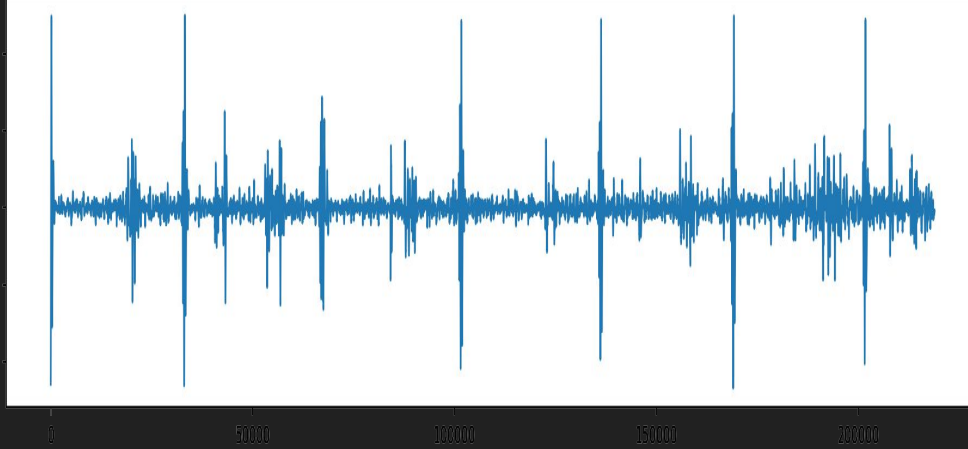
Normal HeartBeat

A normal heart sound has a clear "lub dub, lub dub" pattern, with the time from "lub" to "dub" shorter than the time from "dub" to the next "lub" (when the heart rate is less than 140 beats per minute).

Artifact HeartBeat
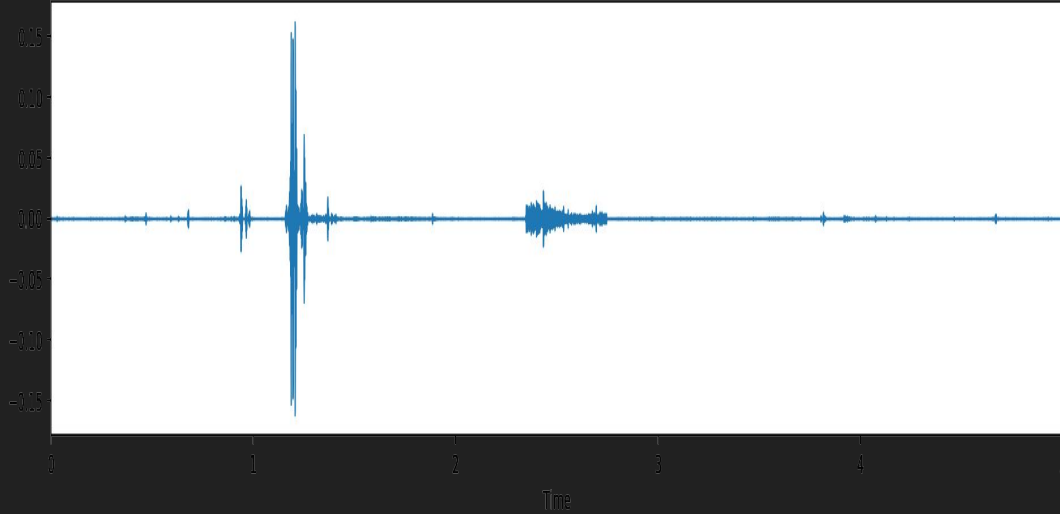
In the Artifact category there are a wide range of different sounds, including feedback squeals and echoes, speech, music and noise.If someone gathering data gets an artifact , he should try again.

Murmur HeartBeat
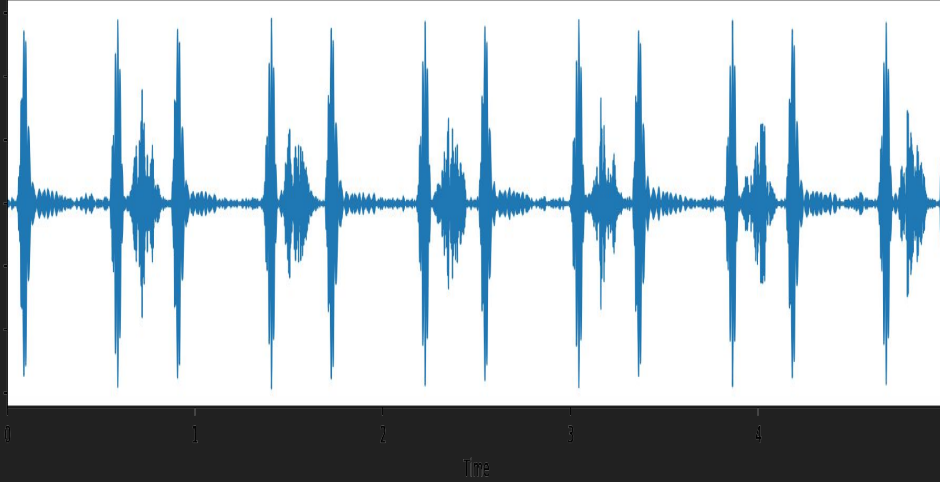
Heart murmurs sound as though there is a "whooshing, roaring, rumbling, or turbulent fluid" noise in one of two temporal locations: (1) between "lub" and "dub", or (2) between "dub" and "lub". They can be a symptom of many heart disorders, some serious.

Extrasystole
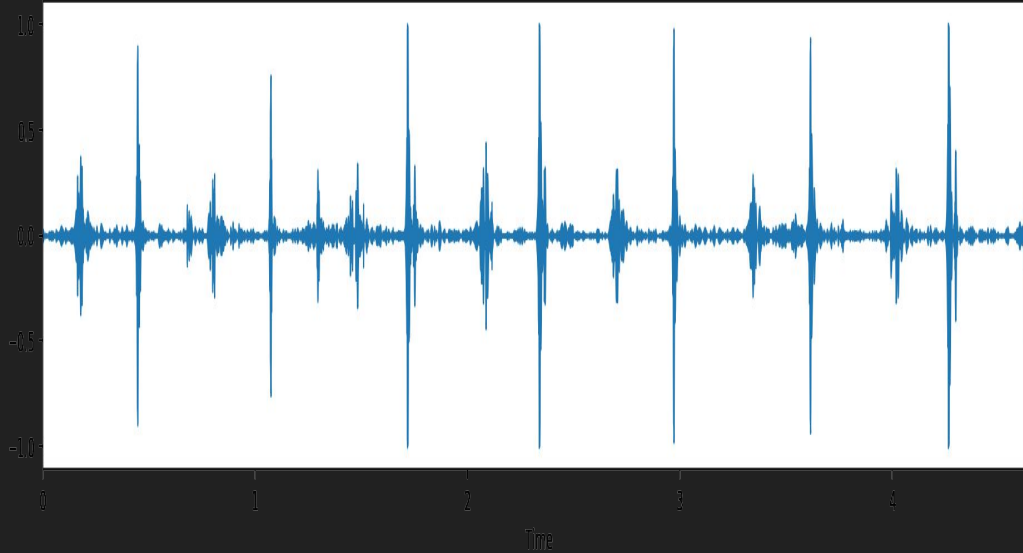
Extrasystole sounds may appear occasionally and can be identified because there is a heart sound that is out of rhythm involving extra or skipped heartbeats, e.g. a "lub-lub dub" or a "lub dub-dub". It can happen normally in an adult and can be very common in children. However, in some situations extrasystoles can be caused by heart diseases.

Dataset Distribution
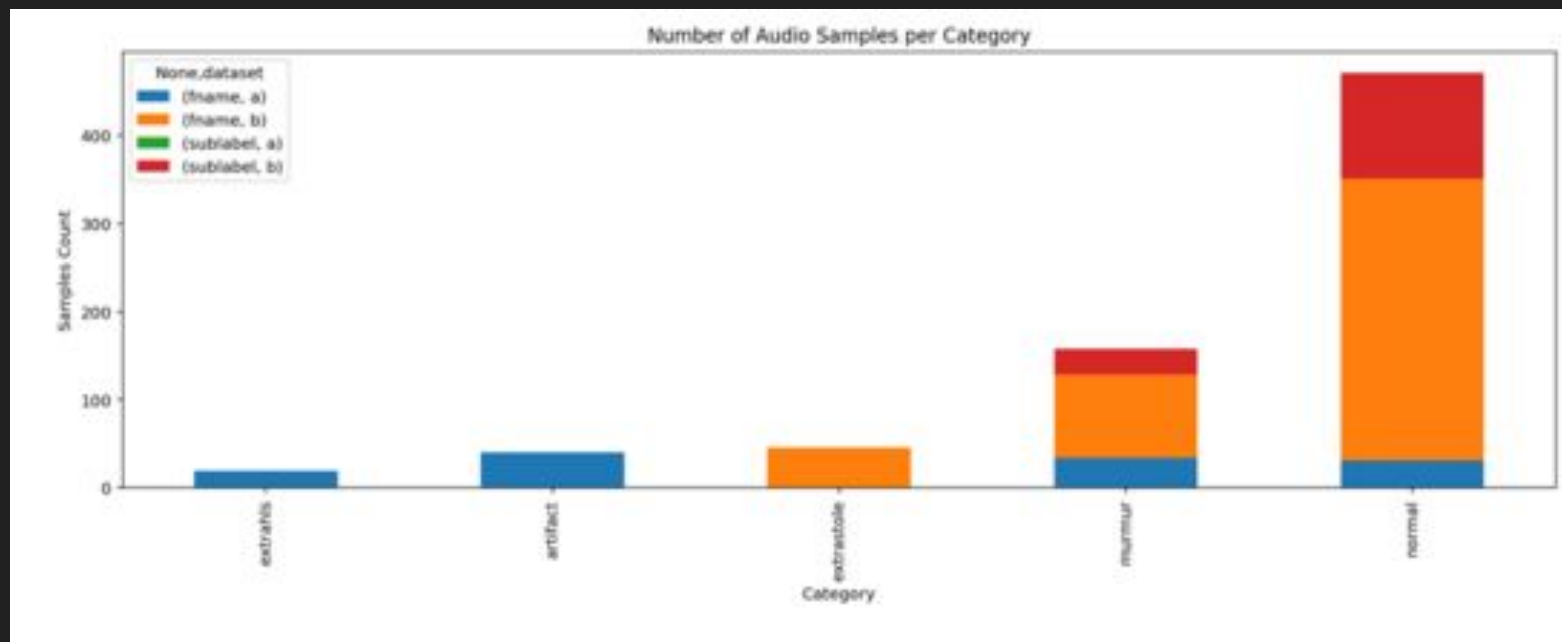
Methodology

- **For Preprocessing:**
    - We used MFCC(Mel Frequency Cepstrum Coefficient) for feature extraction.
        - The mel-frequency cepstrum (MFC) is a representation of the short-term power spectrum of a sound, based on a linear cosine transform of a log power spectrum on a nonlinear mel scale of frequency.
    - Data was very less , so we had broken large signal in 2 second overlapping fashion.
    - Less than 2 second signal were zero padded and used data augmentation and shuffling to make data less biased..

Methodology

- **Model:**

    - We tried number of combination of DL model.
    - Our final model is combination of 1 dimensional CNN layers, dropout, max pooling and Fully Connected layer.
    - We trained model for 32 epochs and 32 batch size
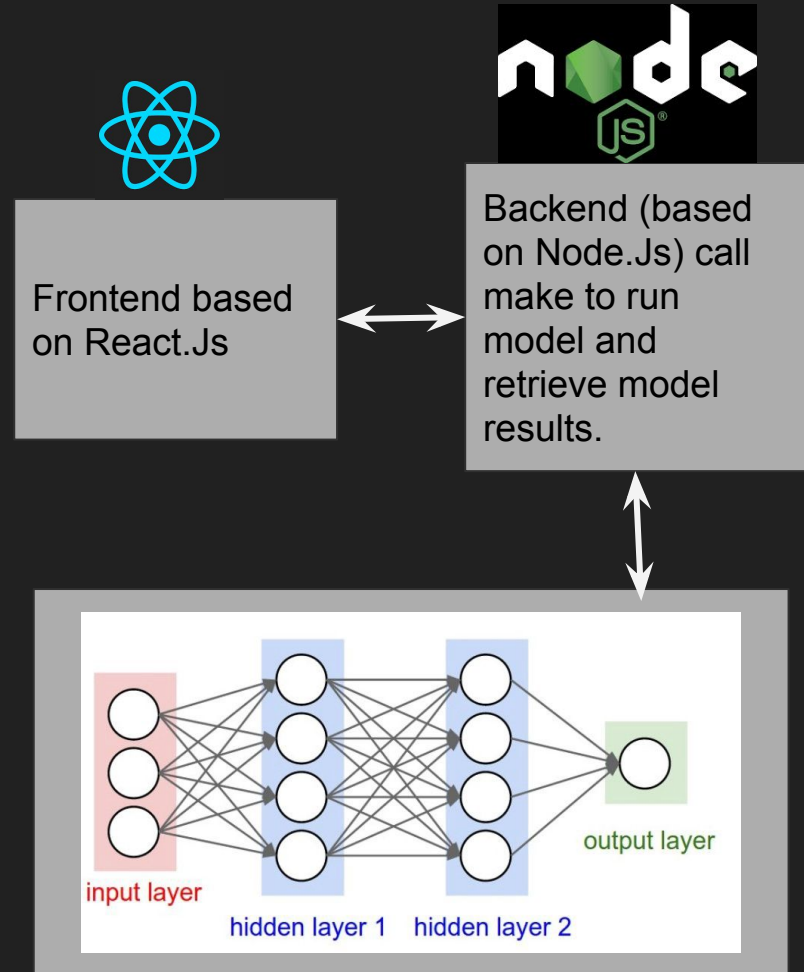
Model Architecture
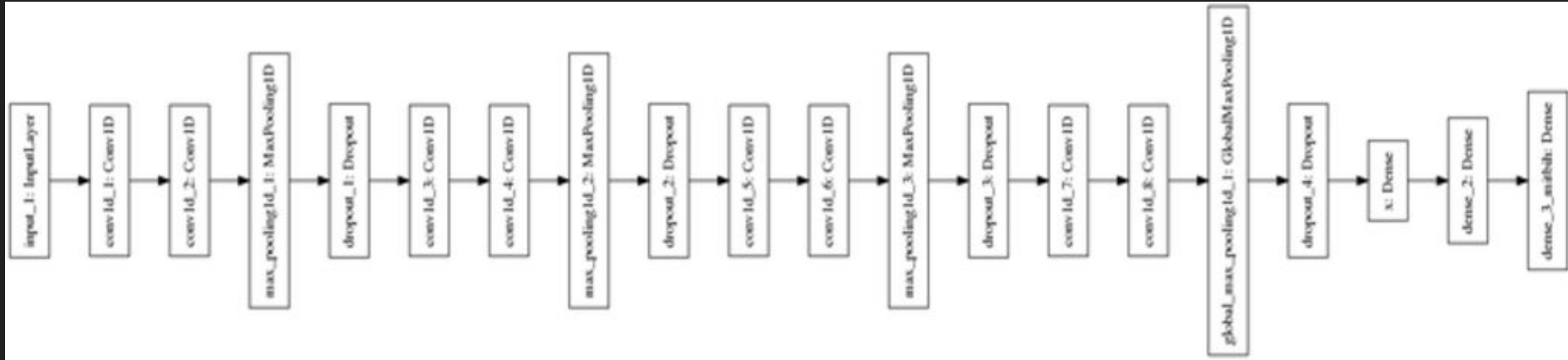
Results

- **Training Time Accuracy: 89%**
- **Testing Accuracy: 94.8%**
- **Accuracy For All data: 96%**

Result shows that Model didn't get overfit as training tome accuracy is less which is due to Dropouts.

End-to-end pipeline

React.Js :- A web framework for building frontend (User Interface) and host the site.

Express.Js :- A backend web framework for Node.Js, to handle request made to certain URL(in our case /upload to upload data and retrieve results) and then make backend calls(like running the model on the user input and generating output).

Frontend based on React.Js

Backend (based on Node.Js) call make to run model and retrieve model results.

Working of the WebApp

1. User logs into the web interface of the app which is hosted on a server(in our case Machine-IP:3000).
2. The UI then gives the user a click button to upload the heart beat audio file.
3. The heart beat file uploaded by the user is sent to the URL Machine-IP:8000/upload where the Node.Js server handles the request of upload using Express plugin.
4. Express stores the file in the local storage and calls the deep learning model to run on the user audio file and return the prediction of heart abnormality with some probability score.
5. This user report data is being sent back from Node.Js to React frontend which then displays the appropriate detailed message of the type of abnormality of the user.

Demo

Thank You