Cardiovascular Diagnosis Using Federated Learning

Department of CSE
Jyothi Engineering College
Thrissur

June 9, 2021

Department Mission & Vision

Vision

- **Creating eminent and ethical leaders in the domain of computational sciences through quality professional education with a focus on holistic learning and excellence.**

Mission

- **To create technically competent and ethically conscious graduates in the field of Computer Science & Engineering by encouraging holistic learning and excellence.**
- **To prepare students for careers in Industry, Academia and the Government.**
- **To instill Entrepreneurial Orientation and research motivation among the students of the department**
- **To emerge as a leader in education in the region by encouraging teaching, learning, industry and societal connect.**

GROUP MEMBERS

1. **ANN MARIYA (JEC16CS026)**
2. **RAHUL M (JEC16CS092)**
3. **MANEESH MANOJ (JEC17CS063)**
4. **RASHI M (JEC17CS079)**

Guide

Mrs. NAMITHA T N
Assistant Professor, Dept. of CSE

Project Github Repository

github.com/mnshmnu/group18

- **Uses decentralized, privacy preserving Federated Learning to diagnose and detect abnormalities in cardiovascular system by observing heart sound.**

The System Aims to:

1. **Privacy oriented approach to conventional Machine Learning**
2. **Implementing Federated Learning in the healthcare sector**
3. **Discovering effective ways to implement Federated Learning technology**

Literature Papers Reviewed

1. **Classification of normal/abnormal heart sound recordings: The physionet-computing in cardiology challenge 2016, Gari D Clifford, Chengyu Liu et.al, 2016**

2. **Federated machine learning: Concept and applications Qiang Yang, Yang Liu, Tianjian Chen, and Yongxin Tong, 2019**

3. **Federated learning for healthcare informatics, Jie Xu, Benjamin S Glicksberg et.al, 2020**

4. **Introduction to federated learning and challenges,Kelvin, 2020**

5. **Classification of heart sounds using convolutional neural network, Fan Li, Hong Tang et.al, 2020**

6. **Spectral images based environmental sound classification using cnn with meaningful data augmentation, Zohaib Mushtaq, Shun-Feng Su, and Quoc-Viet Tran, 2020**

7. **Lung and heart sounds analysis: state-of-the-art and future trends, Ana L Padilla-Ortiz and David Ibarra. 2018**

Existing System

- **Base Paper: Classification of Heart Sounds Using CNN**
- **Key Points:**
  1. **Uses CNN to classify PCG signals of heart sound samples**
  2. **Produced 86% validation accuracy in classifying normal vs abnormal heart sounds**
  3. **Single learning entity**

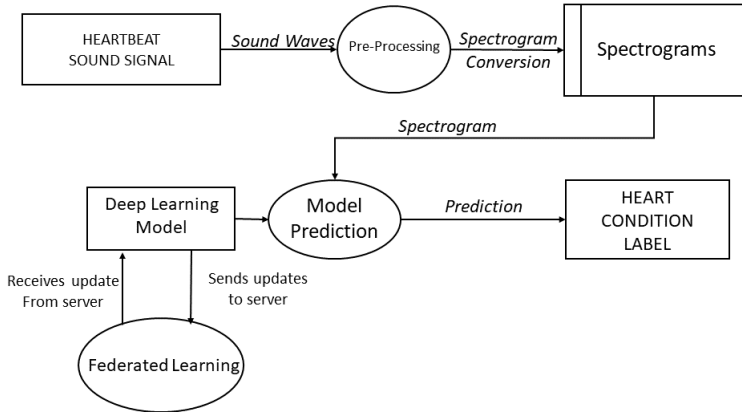# Software Requirement Specifications(SRS)

- **Functional Requirements**
  1. **Detect abnormalities from heart sound and diagnose the disease**
- **Non-Functional Requirements**
 1. **System should maintain Security and Privacy of training data**

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Modules

- **Pre-Processing** ✓
- **Sequential Deep Learning Model** ✓
- **Federated Architecture**
- **User Interface**

Pre-processing

1. **Converting digital audio signal from electronic stethoscope to spectrogram image**
2. **Covert image from RGB to Grayscale**
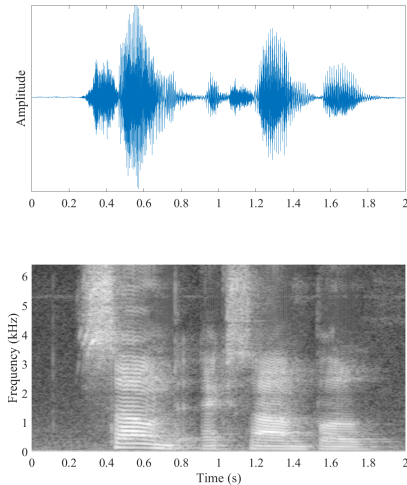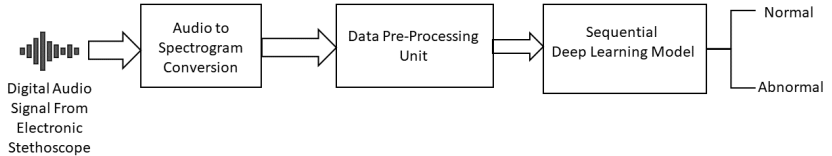3. **Resizes the spectrogram image**
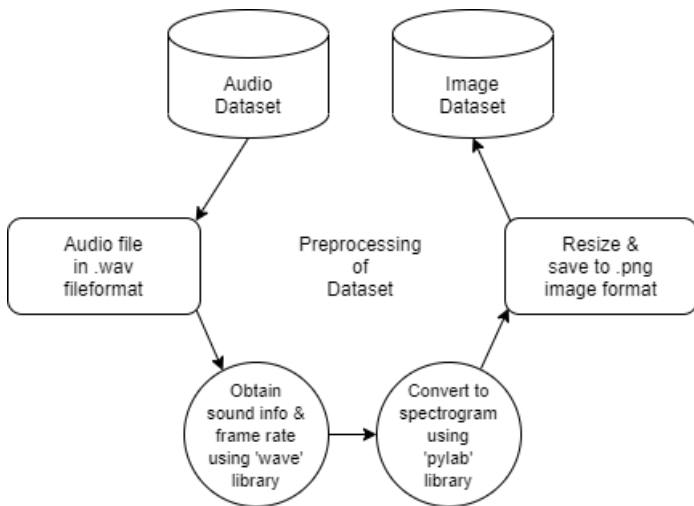
Figure: **Audio signal generated spectrogram**

Deep Learning Model

1. **Model analyses the spectrogram images to predict the heart conditions**
2. **Sequential model with Gated Recurrent Unit(GRU)**
3. **Uses TensorFlow**

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Deep Learning Model Architecture

```
Model: "sequential"

_____
Layer (type)                 Output Shape              Param #
=================================================================
reshape (Reshape)            (None, 234, 698)          0
_____
conv1d (Conv1D)              (None, 55, 196)           2052316
_____
batch_normalization (BatchNo (None, 55, 196)           784
_____
dropout (Dropout)            (None, 55, 196)           0
_____
gru (GRU)                    (None, 55, 128)           125184
_____
dropout_1 (Dropout)          (None, 55, 128)           0
_____
batch_normalization_1 (Batch (None, 55, 128)           512
_____
gru_1 (GRU)                  (None, 55, 128)           99072
_____
dropout_2 (Dropout)          (None, 55, 128)           0
_____
batch_normalization_2 (Batch (None, 55, 128)           512
_____
dropout_3 (Dropout)          (None, 55, 128)           0
_____
time_distributed (TimeDistri (None, 55, 4)             516
_____
flatten (Flatten)            (None, 220)               0
_____
dense_1 (Dense)              (None, 2)                 442
=================================================================
Total params: 2,279,338
Trainable params: 2,278,434
Non-trainable params: 904
```

Contribution of Each Member

1. **Ann Mariya (JEC16CS026)**
   - **Documentation**
2. **Rahul M (JEC16CS092)**
   - **User Interface**
3. **Maneesh Manoj (JEC17CS063)**
   - **Deep Learning Model**
4. **Rashi M (JEC17CS079)**
   - **Dataset Organizing & Pre-Processing**

Future Developments - Timeline

- **Federated Architecture - 20-April-2021**
  1. **Implement Federated Learning**
- **User Interface - 28-April-2021**
  1. **UI for Doctors to interact with the system**
  2. **UI for Patients to access their prescription**

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CONCLUSION

1. **Spectrogram dataset created after pre-processing Audio dataset**
2. **Conventional Machine Learning model implemented**

REFERENCES

📄 **Gari D Clifford, Chengyu Liu, Benjamin Moody, David Springer, Ikaro Silva, Qiao Li, andRoger G Mark.**
`Classification of normal/abnormal heart sound recordings`

📄 **Peter Kairouz, H. Brendan McMahan et. al**
`Advances and Open Problems in Federated Learning`
CoRR, abs/1912.04977, 2019

📄 **Yang, Qiang and Liu, Yang and Chen, Tianjian and Tong, Yongxin**
`Federated machine learning:  Concept and applications`, **ACM TIST, abs/1902.04885, 2019**

📄 **Li, Fan and Tang, Hong and Shang, Shang and Mathiak, et.al**
`Classification of Heart Sounds Using Convolutional Neural Network`, **Applied Sciences, MDPI**

📄 **2018. [Online].**
Available `https://www.tensorflow.org/federated`

Thank You

Any Query?