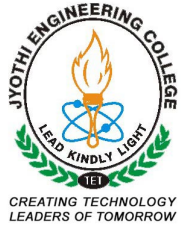
Cardiovascular Diagnosis Using Federated Learning

Department of CSE
Jyothi Engineering College
Thrissur

April 15, 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.**

OUR TEAM

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

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Project Abstract

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

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Project Objectives

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**

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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**

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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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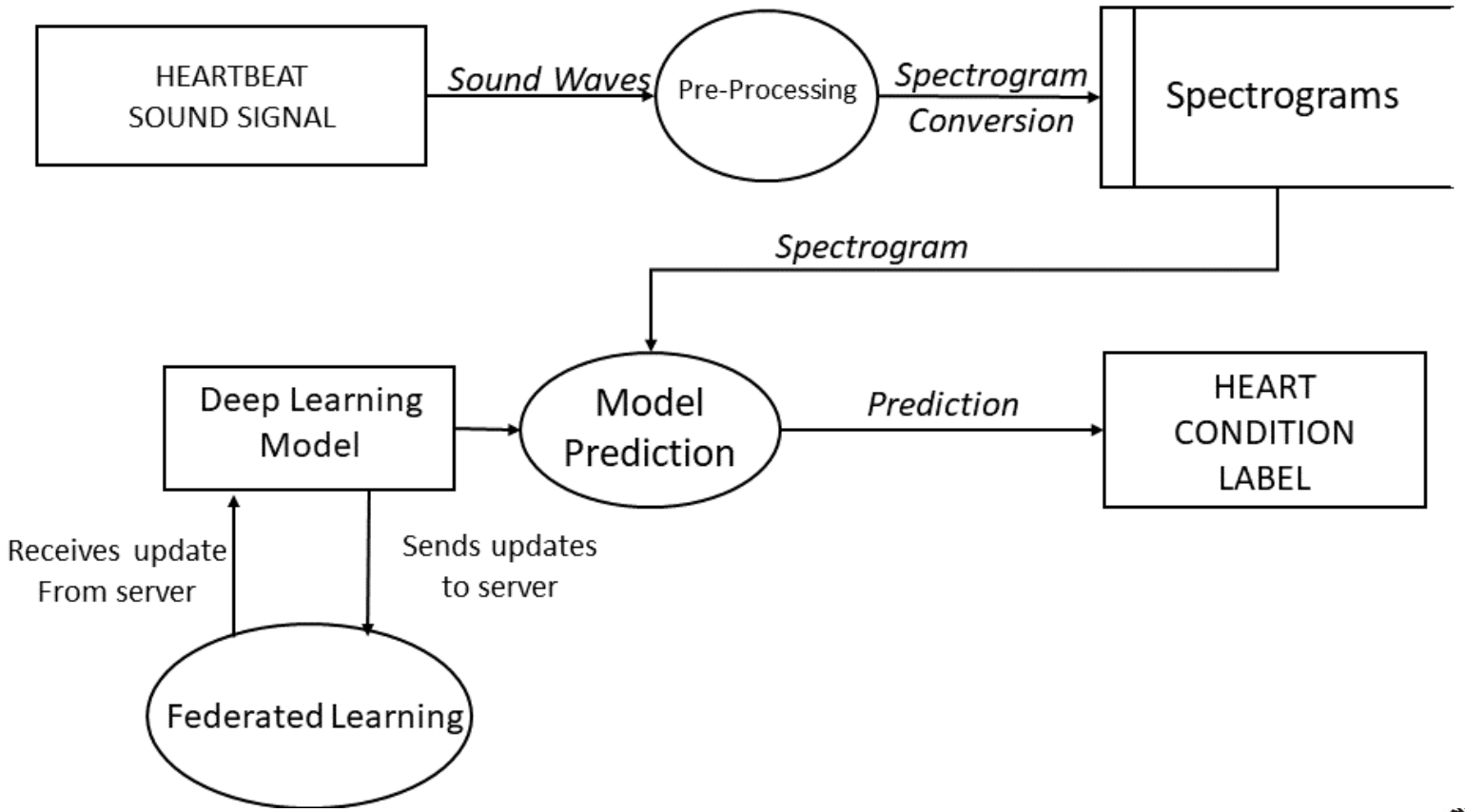
Overall Architecture



Modules

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

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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**

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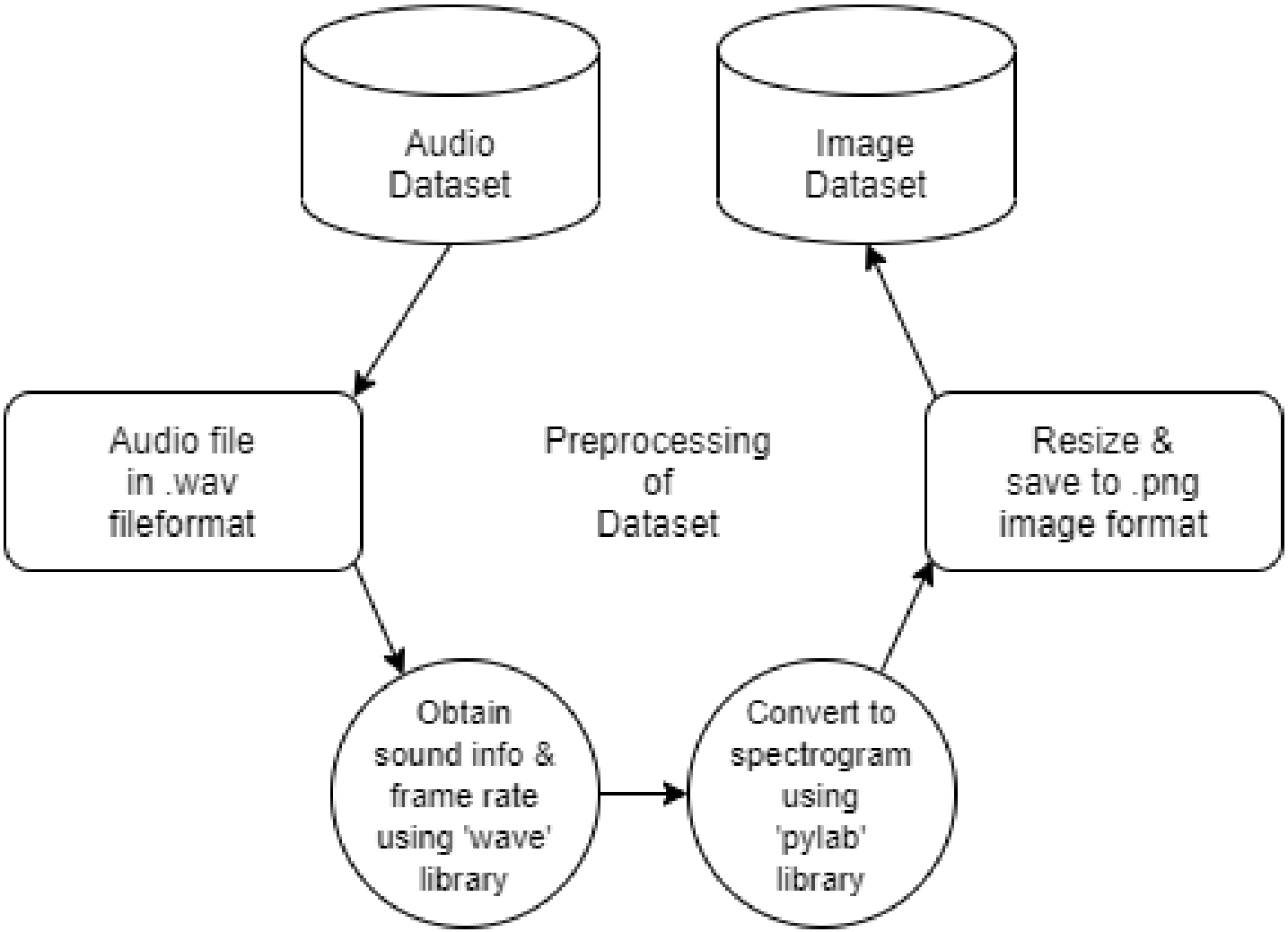
Workflow - Pre-processing



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Output - Pre-processing

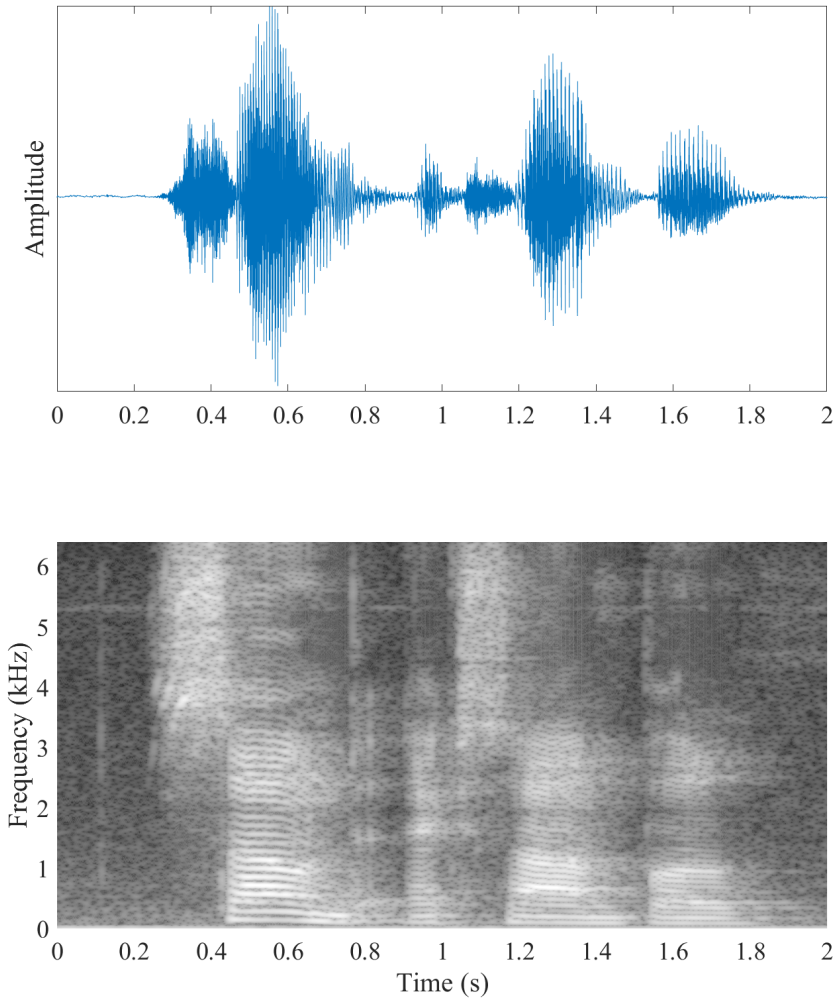

Figure: **Audio signal generated spectrogram**

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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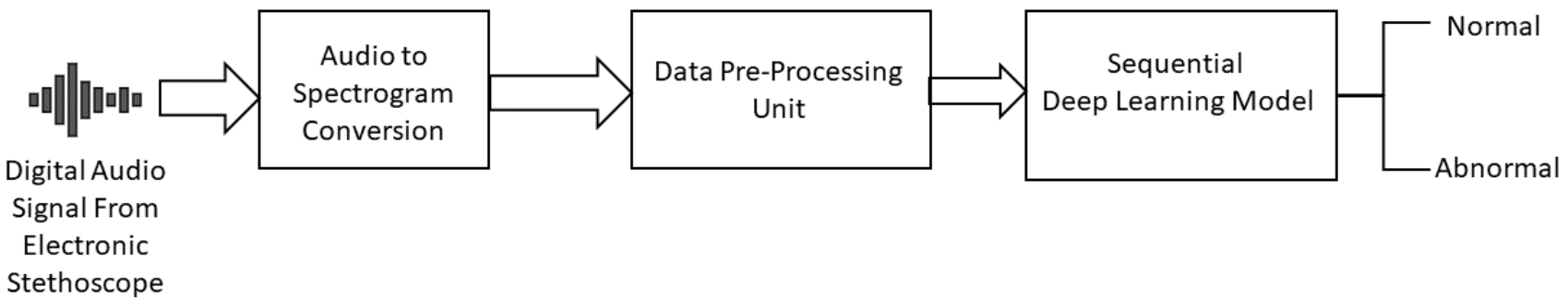
Workflow - Deep Learning model



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
```

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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**

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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**

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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?

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