Cardiovascular Diagnosis Using Federated Learning

Department of CSE
Jyothi Engineering College
Thrissur

January 22, 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

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Assistant Professor, Dept. of CSE

Project Github Repository

github.com/mnshmnu/group18

Project Abstract

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

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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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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**

- **Advantages:**
  1. **Training is comparatively fast**
  2. **Requires less resources**
- **Disadvantages:**
  1. **Collaborative learning not possible**
  2. **No privacy preserving policies raw data is directly shared with orchestrating server**
  3. **Comparatively less accuracy**

Description of the Proposed system

1. **Federated Learning to diagnose heart conditions**
2. **System includes distributed, collaborative, privacy-preserving deep learning architecture that can perform local training on edge devices**
3. **We are using *labeled heart sound* collected by Electronic Stethoscopes as our training data**
4. **The local inference learned by each model are transferred, in a way they cannot be re-engineered to raw data, to a central server**

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1. **Server efficiently aggregate these inferences to form a globally improved model**
2. **This model is transferred to edge devices to create a personalized model using local data, keeping the local data secured at respective devices**
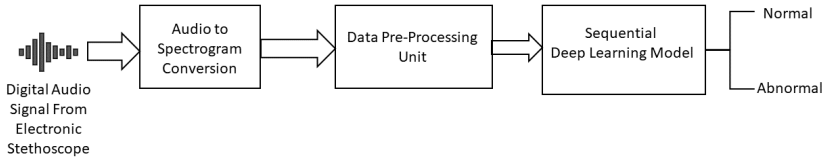3. **The model architecture used is Gated Recurrent Units (GRU)**

Features of Proposed System

1. **Preserves privacy**
2. **Improves the model entity over time**
3. **Facilitate Distributed-Collaborative Learning**
4. **Can process large amount of data,in small amount of time**
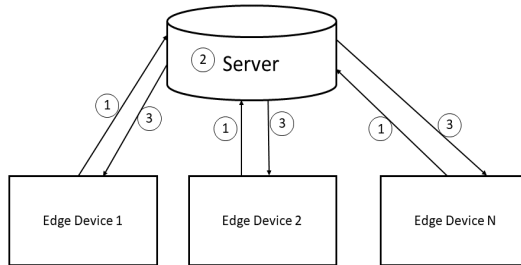5. **Comparatively need less bandwidth to execute Collaborative learning**

Figure: **Distributed Device Architecture**

1 Sending Encrypted Gradients

2 Secure Aggregation

3 Sending back model updates

2. Federated Learning Architecture

Figure: **Federated Learning Architecture**

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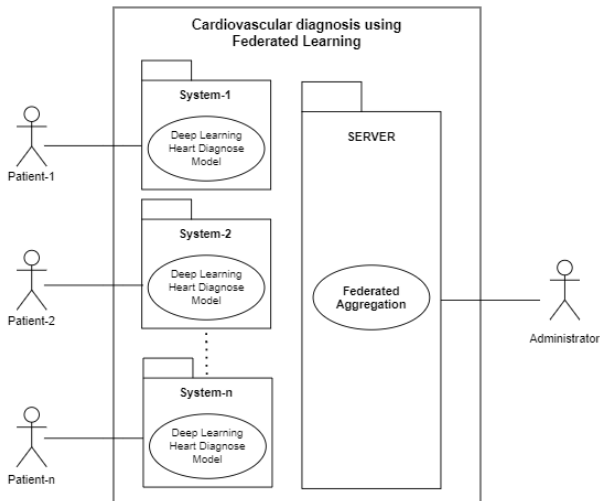
- **Functional Requirements**
  1. **Detect abnormalities from heart sound and diagnose the disease**
- **Non-Functional Requirements**
  1. **System should maintain Security and Privacy of training data**

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Figure: **Use Case Diagram of the Proposed system**

Data Flow Diagram
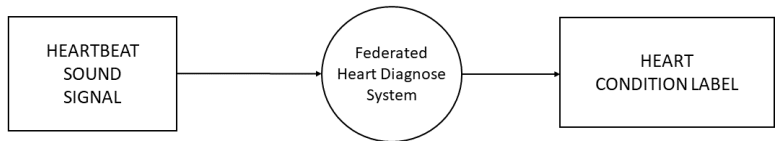
Figure: **DFD - Level 0**
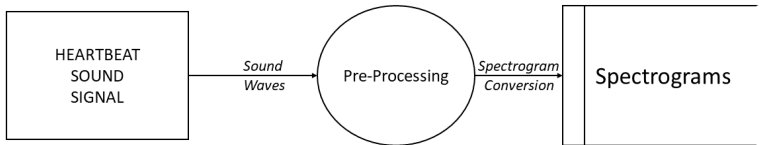
Figure: **DFD- Level 1: Pre-Processing**
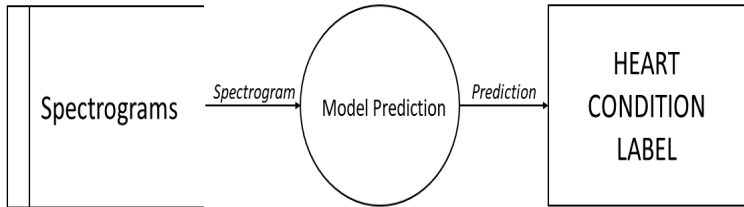
Figure: **DFD- Level 1: Prediction**
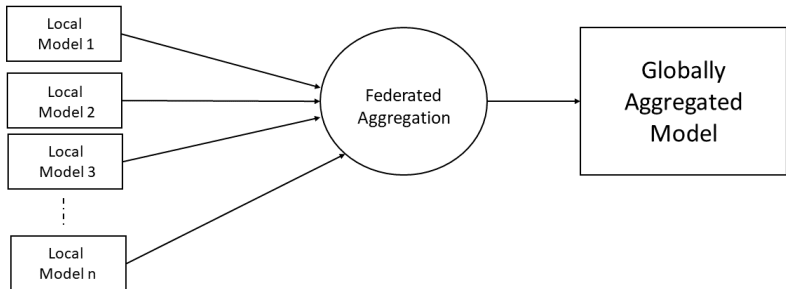
Figure: **DFD- Level 1: Federated Aggregation**
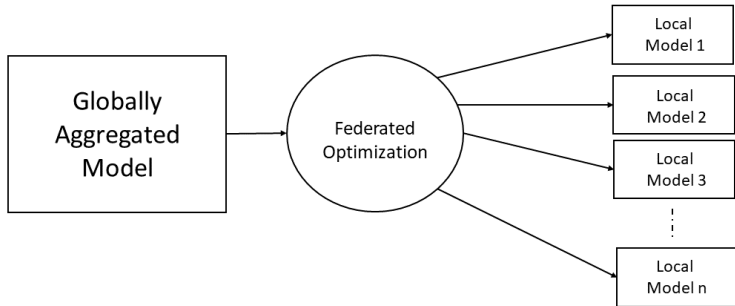
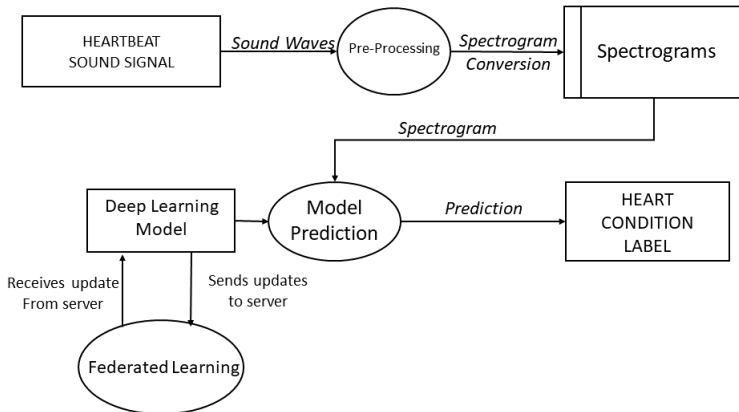Figure: **DFD- Level 1: Federated Optimization**

Figure: **DFD- Level 2: System**

Application of the proposed system

- **Detecting heart abnormalities using:**
  1. **Normal heart sounds**
  2. **Abnormal heart sounds**
- **Aid diagnose of heart conditions non-invasively with limited technology**

Course Outcomes

- **C410.1 The students will be able to analyse a current topic of professional interest and present it before an audience.**
- **C410.2 Students will be able to identify an engineering problem, analyse it and propose a work plan to solve it.**
- **C410.3 Students will have gained thorough knowledge in design, implementations and execution of Computer science related projects.**
- **C410.4 Students will have attained the practical knowledge of what they learned in theory subjects.**
- **C410.5 Students will become familiar with usage of modern tools.**
- **C410.6 Students will have ability to plan and work in a team.**

Course Outcome							
		C418.1	C418.2	C418.3	C418.4	C418.5	C418.6
Program Outcome	1	3	3	1	3	-	-
	2	3	3	2	3	3	3
	3	3	2	3	2	-	1
	4	2	3	1	3	-	3
	5	2	1	2	3	3	3
	6	3	-	3	2	3	3
	7	2	1	2	3	2	1
	8	_	2	1	1	3	2
	9	3	3	3	1	1	1
	10	3	2	2	3	2	3
	11	2	1	1	3	1	2
	12	1	3	1	3	2	3

Figure: **CO-PO Mapping**

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Pending Works

1. **Experiment with various ML models to find the best possible one**
2. **Create a federated dataset to simulate Federated paradigm**
3. **Migrate the current model to Federated Learning paradigm**

CONCLUSION

1. **Abnormal heart conditions are diagnosed from heart sound signal**
2. **Federated Learning enables multiple devices to collaborate and improve together**
3. **Collaborative learning in medical field is possible without sharing the data**

REFERENCES

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CoRR, abs/1912.04977, 2019

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Li, Fan and Tang, Hong and Shang, Shang and Mathiak, et.al
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Available `https://www.tensorflow.org/federated`

Thank You

Any Query?