# Project Synopsis

1. **Title of Project:-** Diagnosing respiratory conditions via lung sound using CNN and LSTM.

2. **Area of Project:** Data Science And Machine learning.

3. **Project team detail :**
1. Pawar Rohit Balaso. (B1911904243)
2. Raut Aditi Shivaji. ( B1911904242)
3. Jadhav Sneha Nitin. ( B1911904252)

4. **Motivation of project**:-

The rapid increase in respiratory diseases globally has spurred interest in audio signal analysis for diagnosis. Advances in computer science have greatly enhanced our ability to analyze media data, allowing for automated processing of audio information. This technology could support healthcare providers by offering fast, reliable diagnostic tools and enabling patient monitoring.

Audio analysis, particularly in auscultation, aids early detection of respiratory issues and is also vital for cardiac assessments. Auscultation is a non-invasive, cost-effective method for evaluating lung conditions, but traditional stethoscopes face limitations, such as susceptibility to external noise and lack of audio frequency filtering. Additionally, there is a risk of diagnostic errors by untrained practitioners.

5. **Input and Output features:-**

**A. Project Scope:-**

The project aims to develop a non-invasive, cost-effective diagnostic tool for respiratory conditions using lung sound analysis. By leveraging CNN and LSTM models, the system will classify lung sounds accurately, providing quick and accessible diagnosis support in both clinical and remote settings, especially beneficial for areas with limited medical resources.

**B. Functional Requirements:-**

The functional requirements for this project include a system where an admin can add users, assign roles, and set permissions for specific activities. Users should be able to log in securely and access functionality based on their permissions. The system should allow users to input patient information and upload lung sound recordings. Once a recording is uploaded, the system should analyze the audio file and provide an accurate diagnosis, highlighting any abnormalities in respiratory sounds. Additionally, a user-friendly interface is essential, offering a clear, accessible platform for input and display of diagnostic results, ensuring efficient operation and ease of use for medical staff.

**C. Nonfunctional Requirements:-**

1. **Performance:** Fast processing with high classification accuracy (>95%).
2. **Safety:** Secure handling of medical data with reliable error handling.
3. **Security:** Robust user authentication and data encryption.
4. **Quality Attributes:**

   **Adaptability:** Compatible with multiple devices.

   **Availability:** 24/7 accessibility.

   **Maintainability:** Easy to update and improve.

   **Reliability:** Consistent accuracy across varied audio inputs.

**D. Advantages:-**

1. **Non-Invasive:** Provides a diagnosis using audio recordings, avoiding invasive procedures.
2. **Cost-Effective:** Reduces the need for costly medical imaging or tests.
3. **Quick Diagnosis:** Enables rapid analysis of respiratory sounds for timely intervention.
4. **High Accuracy:** Uses advanced CNN-LSTM models for reliable classification.
5. **Remote Accessibility:** Can be deployed in remote or resource-limited areas, improving healthcare access.
6. **Ease of Use:** Simple interface for healthcare professionals with minimal training required

**6. Module wise features :-**

1. **Data Collection:** Collects labeled lung sound recordings.
2. **Data Preprocessing:** Cleans audio, removes noise, and formats data.
3. **Feature Extraction:** Extracts key audio features for analysis.
4. **Model Training:** Trains CNN-LSTM model to classify respiratory sounds.
5. **Evaluation:** Tests model accuracy and reliability.
6. **Diagnosis Display:** Shows diagnosis and confidence score.
7. **Admin Panel:** Manages user access and monitors system use.

**7. Software requirement and hardware requirement:**

**Software requirement** :

1) Python: Python 3.6 and higher version

2) Libraries: Numpy, Scipy, Tensorflow, keras, etc.

3) Operating System Windows or Ubuntu

**Hardware requirement** :Processor: 64 bit, quad-core, 2.5 GHz minimum per core

1) RAM: 4 GB or more.

2) HDD: 20 GB of available space or more.

3) Display: Dual XGA (1024 x 768) or higher resolution monitors.

4) Camera: A detachable webcam.

5) Keyboard: A standard keyboard

## 8. Assumption and limitations :

**Assumptions:**

- Device with internet access is available.
- Clear audio recordings are provided.
- Users have basic software knowledge.

**Limitations:**

- Sensitive to background noise.
- Dependent on high-quality training data.
- Requires internet access.
- Limited to audio-based diagnosis only.

## 9. Any future Enhancement :-

Future enhancements for this project include expanding the dataset to improve robustness in noisy environments and isolating lung sounds from background noises like heartbeat sounds for greater accuracy. Additionally, advanced acoustic techniques could further refine sound modeling. Clinical integration is also a priority, aiming to make the system suitable for pulmonary health screening and differential diagnosis. Finally, enhancements could enable the system to identify not only the presence but also the type and severity of respiratory infections, adding valuable diagnostic depth.

## 10. Study Curve :-

This project leverages CNN and LSTM models to diagnose respiratory conditions by analyzing lung sounds, aiming to overcome the limitations of traditional auscultation, which can be prone to noise interference and diagnostic errors. The system involves key steps: lung sound data collection, audio preprocessing into spectrograms, feature extraction via CNNs, and temporal pattern recognition through LSTM layers. This approach enables the model to classify respiratory sounds and assist in early detection of conditions like asthma, COPD, and pneumonia.

The project's learning curve has focused on understanding audio signal processing, effective use of neural networks for time-series data, and rigorous model optimization to improve classification accuracy. Results indicate a high potential for accurate, fast, and non-invasive diagnostics, making the system valuable for clinical applications. Future enhancements include scaling the dataset, developing better noise isolation techniques, and refining the model for practical, clinical use. This work demonstrates the practical application of machine learning in respiratory health, showing significant promise in advancing accessible and reliable diagnostic tools.

**11. Expectations from Department :-**

For more effective system we expect a Digital Stethoscope which will help us to record patients lungs sounds at real time.

**Signature**
**(Prof. Shah S. N.)**
**Internal Guide**

**Signature**
**External Guide**