Content

Introduction

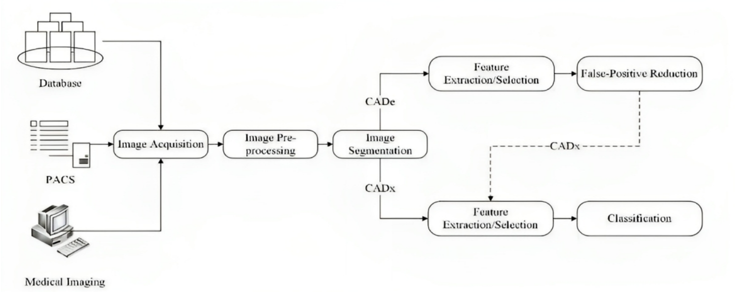
Why we select this project?

- We have chosen the TB detection system for its exceptional capability in the early detection of tuberculosis.
- High TB burden regions lack adequate screening tools, causing diagnostic delays and misdiagnosis. Hence, computer-aided systems are developed for automatic TB detection.
- In summary, our choice of the TB detection system underscores our commitment to proactive healthcare strategies that prioritize early detection as a means to enhance patient outcomes and public health.

Existing Solutions

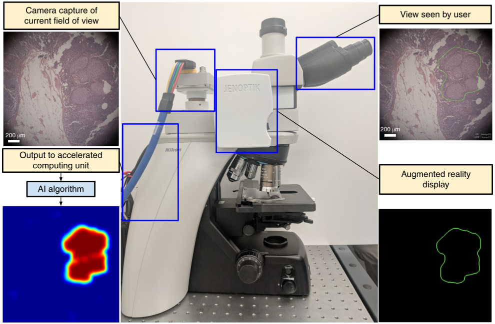
- AI-Enhanced Microscopy
- Electronic Health Records (EHR)
- Computer aided detection (CAD) for chest radiographs
- Chest X-ray Analysis
- Sputum Smear Microscopy
- Cough Sound Analysis
- Gene Expression Profiling
- Direct microscopy
- Molecular tests
- Line probe assays
- Whole genome sequencing (WGS)
- Culture-based drug sensitivity testing (DST)
- Serum biomarkers

Computer-Aided Detection (CAD)



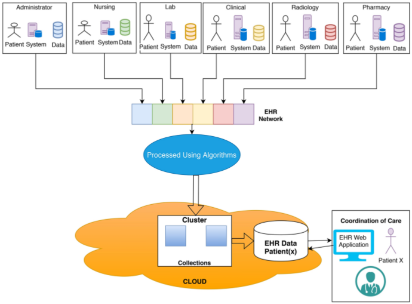
Computer-Aided Detection (CAD) is a medical technology that utilizes computer algorithms and imaging data to assist healthcare professionals in identifying and diagnosing diseases, such as cancer or neurological disorders, by providing automated analysis and detection capabilities.

AI-Enhanced Microscopy



"AI-enhanced microscopy" refers to the integration of artificial intelligence techniques with microscopic imaging to improve and automate the analysis of biological or material samples.

Electronic Health Records (EHR)



Electronic Health Records (EHR) are digital versions of patient medical records that provide secure and efficient access to a patient's health information for healthcare professionals, enhancing the quality of care and medical management.

Literature Review

- **Title:** Deep learning-based automatic detection of tuberculosis disease in chest X-ray images.
- **Dataset & preprocessing:** The study used the Shenzhen set and Montgomery County X-ray Set for TB detection. After scaling to 256x256 pixels, 2040 photos (49.2% TB and 50.8% normal) were used for training, while 120 photos each were used for validation and testing.
- **Methodology:** Deep Convolutional networks and assessed the effectiveness of six CNN models for TB CXR image detection. Pre-trained models such as Inception v3, Xception, ResNet50, VGG19, and VGG16 were used.
- **Result:** Accuracy = 90.0% **&** ResNet50 and VGG16 models performed better than other CNN models on enriched datasets.

Literature Review

- **Title:** Deep-learning : A Potential Method for Tuberculosis Detection using Chest Radiography.
- **Dataset & preprocessing:** The study used the Shenzhen set and Montgomery County X-ray Set for TB detection.
- **Methodology:** In this paper, we have proposed a deep CNN-based method for TB detection. CNNs are based on feed-forward neural network architectures and automatic selection of features. The performance of extracted features in CNN depends on the depth of the architecture.
- **Result:** Accuracy = 94.73% .They also showed that performance of the network is much better with transfer learning as compared to the network without transfer learning.

Literature Review

- **Title:** Reliable Tuberculosis Detection using Chest X-ray with Deep Learning, Segmentation and Visualization.
- **Dataset & preprocessing:** In the Montogomery country,out of 138 chest X-ray images, 58 images were taken from different TB patients and 80 images were from normal subjects.In the CNN database,out of 662 chest X-ray images,336 images were taken from different TB patients and 324 images were from normal subjects.
- **Methodology:** Nine different CNN models were evaluated for the classification of TB and normal CXR images.ChexNet model outperforms other deep CNN models for the datasets without image segmentation whereas DenseNet201 outperforms for the segmented lungs.
- **Result:** Accuracy= 97.07%.

Problems In Existing System

Computer-Aided Detection(CAD)

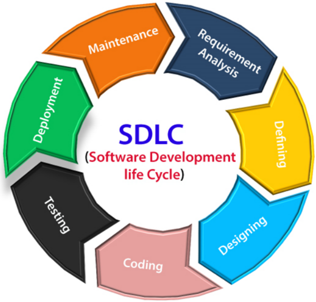
- Data Collection and Quality Assessment.
- Segmentation Approaches for Medical Imaging.
- Feature Extraction Selection Approaches for Image and Signal Analysis.
- Classification and Other Data Mining Approaches.
- Dealing with Big Data.
- Performance Assessment for CAD Systems.
- Adopting CAD Systems for Clinical Practice.
- Data Security: Ensuring patient data privacy.

Solutions to an existing problem

Feature Extraction / Selection Approaches for Image and Signal Analysis

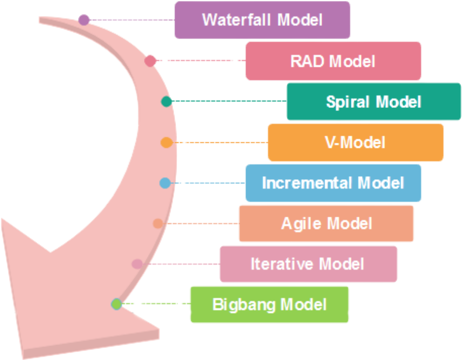
- Following are strategies to improve feature extraction:
  - Image Enhancement
  - Noise Reduction
  - Model Ensemble Methods
  - Continual Improvement
- Following are strategies to improve image and signal analysis:
  - Deep Learning-Based Analysis i.e., CNN
  - Multi-Modal Data Integration i.e., Combine Clinical Data
  - High-Quality Data Collection
  - Data Diversity

SDLC (Software Development Life Cycle)



- SDLC (also termed process model) is a pictorial and diagrammatic representation of the software life cycle.
- A life cycle model maps the various activities performed on a software product from its inception to retirement.

Types of SDLC Models



- There are different SDLC models. Each process model follows a series of phase unique to its type to ensure success in development of an efficient software.

Related SDLC Model

Agile Model

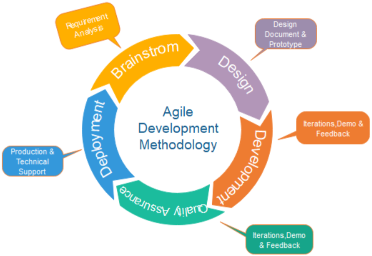


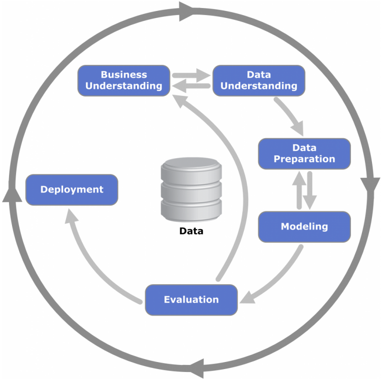
Fig. Agile Model

- The meaning of Agile is **swift or versatile**. "Agile process model" whose approach is based on iterative development.
- Agile methods break tasks into smaller parts which do not directly involve long term planning.

Selected Methodology

CRISP-DM

- The CRISP-DM stands for **Cross-Industry Standard Process for Data Mining**.
- The process consists of six major phases:



Phases of CRISP-DM

- **Business Understanding:** Understand the medical objectives, patient needs, and project goals for tuberculosis detection.
- **Data Understanding:** Acquire and explore medical imaging data (X-rays, CT scans) relevant to tuberculosis detection.
- **Data Preparation:** Clean, preprocess, and format the data, ensuring it's suitable for deep learning.
- **Modeling:** Develop deep learning models, experimenting with different architectures and techniques.
- **Evaluation:** Assess model performance using metrics like sensitivity, specificity, and ROC-AUC.
- **Deployment:** Implement the model in a healthcare setting for real-world tuberculosis screening.
- **Monitoring**: Continuously monitor the model's performance and update as necessary.

Pros of CRISP-DM

- **Structured Approach:** Consists of clear stages, which makes it easier to manage and plan the project.
- **Flexibility:** Could be adapted to various types of AI projects including classification, regression, clustering, and more.
- **Supports Collaboration:** Encourages collaboration between different stakeholders, including data scientists and domain experts.
- **Risk Management:** Valuable in AI projects where unexpected challenges can arise.

Cons of CRISP-DM

- **Complex:** Disadvantage for small projects or projects with limited resources.
- **Documentation Overhead:** Encourages extensive documentation at each stage, which is time-consuming.
- **Not Agile-Friendly:** Preferred for fast-paced AI and software projects.

Why we selected CRISP-DM Methodology

- We selected the CRISP-DM (Cross-Industry Standard Process for Data Mining) methodology because it provides a structured framework for addressing the complex task of tuberculosis detection.
- It enables us to systematically understand medical objectives, work with diverse medical imaging data, prepare it effectively, experiment with various deep learning models, evaluate their performance, and deploy a reliable solution in healthcare.
- CRISP-DM's comprehensive approach ensures a well-organized and efficient workflow for this critical medical project.

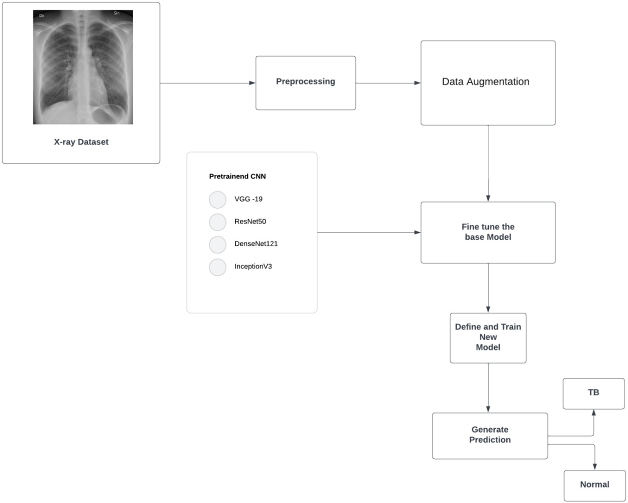
Problem Statement

- **"Create a deep learning model for automated tuberculosis detection in chest X-ray images, focusing on effective feature extraction and selection techniques for image analysis."**

Content

- Architecture Diagram.
- Data Flow Diagram(DFD).
- Schematic Diagram.
- Gantt Chart.
- Activity Diagram.
- Usecase Diagram.

Architecture Diagram



- Architecture diagram for tuberculosis detection using deep learning involves outlining the different components and their connections in the system.
- **Some Components Of Architecture Diagram**:
  Data Collection: We obtained a publicly available X-ray dataset for tuberculosis detection from Kaggle, which will be utilized in our research on developing a deep learning model for automated tuberculosis diagnosis.
  Data Preprocessing: Images are preprocessed to enhance features and reduce noise.
  Data Augmentation: Augmentation techniques may be applied to increase the diversity of the training dataset.
  Fine Tune The Base Model: We fine-tuned a pre-existing deep learning model for tuberculosis detection using a Kaggle X-ray dataset.

Deep Learning Models:
VGG-19
ResNet50
DenseNet21
Inceptionv3
Generate Prediction: Our trained deep learning model accurately predicts tuberculosis presence in X-ray images, contributing to improved early detection and diagnosis in healthcare.
The tuberculosis detection model distinguishes between TB and normal cases in X-ray images, providing a binary classification for effective diagnosis in healthcare settings.

Data Flow Diagram

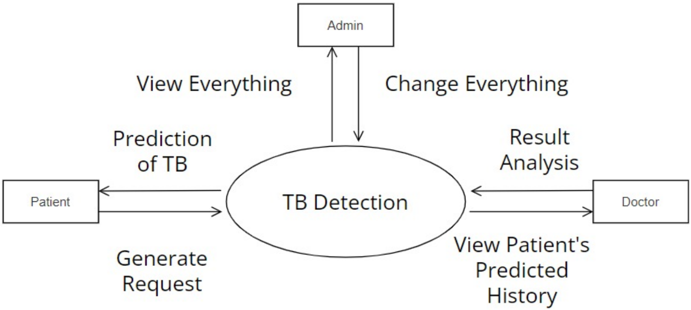
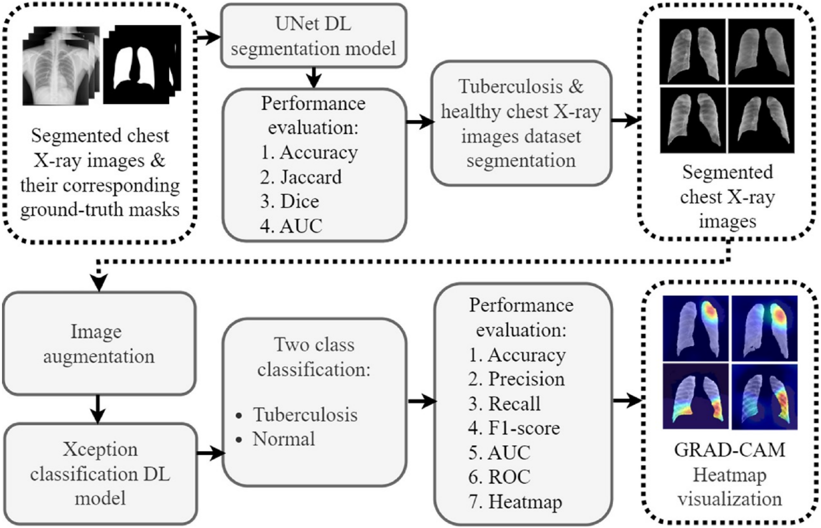


Figure: Data Flow Diagram For Tuberculosis Detection.

Data Flow Diagram

- In the Data Flow Diagram, patients initiate requests in the Tuberculosis Detection System, which predicts tuberculosis. Doctors then access patients' predicted history, generate analysis results.
- Admin has full access to view and modify all aspects as needed.

Schematic Diagram



Schematic Diagram

- In medical imaging and deep learning models, a schematic diagram could illustrate the flow of data and processes, such as the journey from segmented chest X-ray images to the application of a UNetDL Segmentation Model and then to the evaluation metrics.
- The diagram might use symbols or icons to represent different components of the system and arrows to indicate the flow of information or processes.

Gantt Chart

Figure: Gantt Chart For Tuberculosis Detection

Gantt Chart

- **1. Literature Review (2 weeks)**
  Research existing methods in tuberculosis detection using deep learning.
  2.Data Collection and Preprocessing (4 weeks) Collect and preprocess chest X-ray images for the dataset.
  3.UNetDL Segmentation Model:
  a. Designing (3 weeks)
  b. Implementing (4 weeks)
  c. Training (6 weeks)
  d. Evaluating (3 weeks)
  e. Optimization (4 weeks)
  4.Tuberculosis Dataset Augmentation
  a. Collection (3 weeks)
  b. Image Augmentation (2 weeks)

Gantt Chart

- **5. Xception Classification Model**

  a. Designing (3 weeks)

  b. Implementing (4 weeks)

  c. Training (6 weeks)

  d. Evaluating (3 weeks)

  e. Optimization (4 weeks)

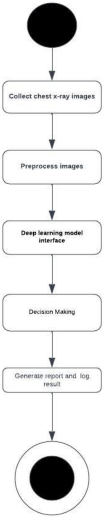
  6. Results Analysis and Reporting (4 weeks)

  Analyze results from segmentation and classification models.

  7. Documentation and Reporting (3 weeks)

  Compile project documentation and generate a final report.

Activity Diagram



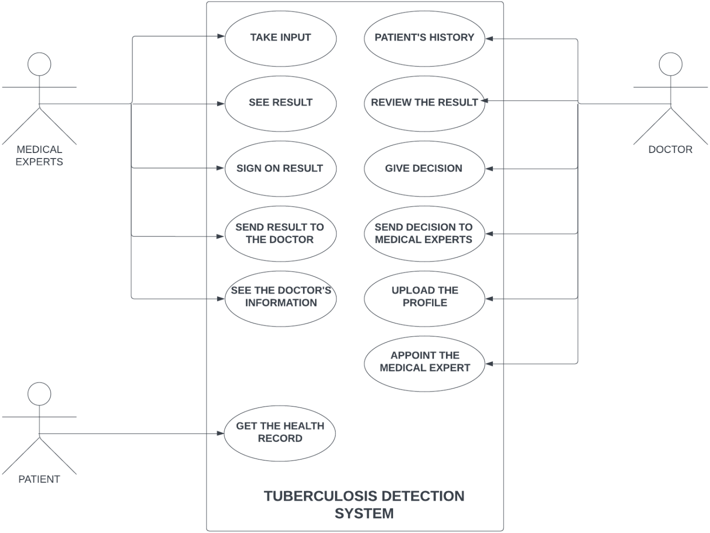
Activity Diagram

- This activity diagram outlines the process of utilizing deep learning for chest X-ray analysis. Here's a concise explanation of each step:
- **Collect Chest X-ray images:** Gather a dataset of chest X-ray images for analysis.
- **Preprocess image:** Prepare the collected images for deep learning by applying necessary preprocessing steps, such as resizing, normalization, or noise reduction.
- **Deep Learning interface:**Employ a deep learning model or interface for image analysis, using techniques like convolutional neural networks (CNNs) tailored for medical image recognition.

Activity Diagram

- **Decision Making:**Leverage the deep learning model to make diagnostic decisions based on the analyzed chest X-ray images. This step involves the model's ability to identify patterns or abnormalities indicative of various medical conditions.
- **Generate report and log result:**Based on the decisions made by the deep learning model, generate a comprehensive report summarizing the findings. Additionally, log the results for future reference or analysis.
- In summary, this activity diagram illustrates the streamlined process of collecting, preprocessing, and analyzing chest X-ray images using a deep learning interface, leading to decision-making and the generation of detailed reports with logged results.

UseCase Diagram



UseCase Diagram

- **Actors:**
- **1.Radiologist:**
  View Patient History: Retrieve and review patient X-ray history.
  Upload X-ray Images: Input new chest X-ray images for analysis.
  Trigger Deep Learning Analysis: Initiate the deep learning algorithm for TB detection.
  Review Deep Learning Results: Examine the outcomes of the algorithm's analysis.
  Generate Diagnosis Report: Obtain a detailed report summarizing the TB diagnosis.

UseCase Diagram

- **2.System:**
  Preprocess X-ray Images: Prepare uploaded X-ray images for deep learning analysis.
  Apply Deep Learning Algorithm: Utilize a deep learning model for TB detection.
  Decision Making (TB Detection): Make diagnostic decisions based on deep learning analysis.
  Generate Report: Create a comprehensive report detailing TB detection results.
  Log Results: Record diagnostic outcomes for future reference.

UseCase Diagram

- **3.Administrator:**
  Manage User Accounts: Control user access and permissions.
  Monitor System Performance: Ensure the efficient operation of the TB detection system.
  Update System: Implement necessary updates and improvements.

Thank You