3. Requirements Gathering

3.1 Stakeholder Analysis

Stakeholder	Role in the Project	Needs & Expectations
Hospital Administrators & Management	Oversee hospital operations and capacity planning	Need accurate predictions of ICU bed usage, ventilator demand, and patient admissions to manage hospital resources efficiently.
Doctors & Healthcare Workers	Provide direct care to COVID-19 patients	Require patient severity insights and predictions on whether a patient may need ICU or ventilator support. They also need easy-to-use dashboards to access real-time data.
Government Health Agencies	Plan and implement public health strategies	Need regional data on COVID-19 trends, hospital strain reports, and resource distribution predictions to make informed decisions.
Patients & General Public	Seek care and information on hospital availability	Want transparency on hospital bed availability, estimated waiting times, and COVID-19 trends to make informed healthcare choices.
Data Scientists & Researchers	Analyze trends and optimize prediction models	Need clean, reliable datasets for research, validation of AI models, and contribution to broader epidemiological studies.
Software Engineers & Developers	Build and maintain the predictive system	Require well-defined system requirements, scalable architecture, and clear documentation to ensure smooth development and deployment.

User Role	User Story
Hospital Administrator	As a hospital administrator, I want to predict ICU demand so that I can allocate resources efficiently.
Doctor	As a doctor, I want to receive real-time insights on patient severity to prioritize treatments.
Government Health Official	As a health official, I want to analyze COVID-19 trends to adjust public policies accordingly.
Patient	As a patient, I want to see hospital bed availability before visiting a hospital.
Data Scientist	As a data scientist, I want access to a clean dataset to improve prediction models.
Software Engineer	As a developer, I want well-documented APIs and system architecture to implement features efficiently.

3.2 User Stories & Use Cases3.3 Functional Requirements

Description & Applications	Description
Data Collection and Processing	The system gathers COVID-19 patient data from hospitals, government sources, and real-time monitoring systems. Data is processed, cleaned, and structured to ensure accuracy before analysis. (Application: Reliable input for predictive modeling and reporting.)
Predictive Modeling and Insights	Machine learning models analyze patient data to predict ICU demand, ventilator needs, and hospital resource allocation. (Application: Helps healthcare providers plan resource distribution.)
Data Visualization and Reporting	The system generates dynamic dashboards and reports that present real-time trends, infection rates, and hospital capacity. (Application: Enables quick decision-making for hospital administrators.)
User Access and Authentication	Secure authentication system ensuring only authorized personnel, such as hospital administrators and health officials, can access sensitive data. (Application: Maintains data security and compliance.)
Alerts and Notifications	Automated alerts notify healthcare professionals when hospital capacity reaches critical levels or COVID-19 cases surge. Integration with Hospital Management SystemsApplication: Helps hospitals prepare for demand spikes.)
Integration with Hospital Management Systems	the system connects with existing hospital databases and resource planning tools, enabling seamless data exchange. (Application: Reduces manual data entry and ensures accuracy.)

3.4 Non-Functional Requirements

Requirement ID	Description
System Responsiveness	Queries and reports are processed within two seconds, ensuring real-time insights. (Application: Enhances usability for time-sensitive decisions.)
Security and Privacy Measures	Data encryption and role-based access control prevent unauthorized access. (Application: Ensures compliance with healthcare data regulations.)
Scalability and Reliability	Designed to handle large data volumes efficiently, ensuring performance remains stable under heavy usage. (Application: Supports long-term system growth.)
Compliance with Regulations	The system adheres to global healthcare and data privacy standards like GDPR and HIPAA. (Application: Guarantees legal and ethical data handling.)
User Experience and Accessibility	The interface is designed for usability, ensuring accessibility for all healthcare professionals. (Application: Reduces errors and increases efficiency.)
Maintainability and Upgradability	The system is built with modular components to allow easy updates and maintenance. (Application: Ensures long-term adaptability and cost efficiency.)

3 .5 Previous Use Cases for COVID-19 Data

Use Case	Application
Epidemiological Insights	Track infection rates (R0 calculation), evaluate lockdown/vaccination effectiveness.
Healthcare Resource Planning	Predict ICU bed demand, model ventilator or vaccine distribution.
Demographic Risk Analysis	Study mortality rates by age, gender, or pre-existing conditions (e.g., diabetes).
Economic Impact Modeling	Correlate case spikes with economic indicators (e.g., unemployment).
Risk prediction	prediction death situation of covid 19.

3.6 Machine Learning Algorithms

Algorithm	Application	Accuracy
Logistic Regression	Predict risk level of COVID-19 based on patient characteristics	70–90% for ICU admission prediction
Multilayer Perceptron (MLP)	Neural network model for mortality prediction	88% for mortality prediction
Convolutional Neural Network (CNN)	COVID-19 detection from X-rays	90–95% for COVID-19 detection
XGBOOST	COVID-19 death prediction	64% for prediction
Multilayer Perceptron	prediction whether the patient is at risk or not.	85% for prediction

3.7 External Data Sources

Source	Link
COVID-19 Dataset on Kaggle	https://www.kaggle.com/datasets/meirnizri/covid19-dataset
COVID-19 Dataset Code on Kaggle	https://www.kaggle.com/datasets/meirnizri/covid19-dataset/code