SOFTWARE REQUIREMENTS SPECIFICATION

For

EXAMINING DIAGNOSTIC CAPABILITIES OF COVID-19

Under the Supervision of

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1. Introduction

1.1 Purpose

The main objective of this document is to illustrate all the requirements of detecting covid-19 using deep learning. The document gives the detailed description of both functional and non-functional requirements proposed by the client. The main purpose of this project is to provide the accuracy in detecting covid-19 from deep feature extraction of various images of dataset.

1.2 Intended Audience and Reading Suggestions

Anyone with some programming experience and familiarity with Python can understand this document. The document is intended for developers, software architects, testers, project managers, and documentation writers.
This Software Requirement Specification also includes:

- Overall description of the Project
- External interface requirements
- System Features
- Other non-functional requirements

1.3 Project Scope

- The scope of this project includes the development of a friendly website for Patients Who are suffering with Covid-19. This project aims to develop an automated system that analyses X-ray images using CNN for a robust and efficient way to diagnose Covid-19 infection.
- It also indicates Which part in lungs are affected to Covid using Grad-CAM technique.

1.4 References

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2. Overall Description

2.1 Project Perspective

Early diagnosis of the novel corona virus is extremely important to avoid further spread of the virus to others. Along this work, we design a method based on deep transfer learning that uses chest X-ray images related to patients affected with COVID-19 and patients without COVID- 19 to automatically detect the disease. According to our research results, due to its high overall performance, we believe it is of nature to help doctors and health experts make clinical decisions. To discover COVID-19 as early as possible, this study has an in-depth understanding of how to use deep transfer learning approaches.

2.2 Project Functions

- To detect if a person is infected by virus.
- To reduce False Positives and Negative.
- Interoperability.
- Enhanced Generalization.

2.3 User Classes and Characteristics

- The users of the system will be individuals who need to know whether they have covid or not.

- Advanced/Professional Users, Such as Doctors or Researchers, who want to use it for further research.

- Programmers who are interested in working on the project by further developing it or fixing an existing bug.

2.4 Operating Environment

The system will be compatible with
- Windows 7
- Windows 8
- Windows 10
- Mac OS X
- Linux

2.5 Design and Implementation Constraints

Design and implementation constraints for this project, which focuses on developing an automated system for Covid-19 detection using X-ray images and Deep learning techniques, can include various factors that may influence the project's success and execution. Here are some design and implementation constraints to consider:

1. Data Availability and Quality:
- Constraint: Limited and potentially unbalanced dataset of X-ray images for Covid-19 and other conditions.
- Impact: Insufficient data can affect the model's training and generalization capabilities.

2. **Computational Resources:**
- Constraint: Limited access to high-performance GPUs or cloud computing resources.
- Impact: Slower training times and potential scalability issues.

3. **Algorithm Complexity:**
- Constraint: Limited development time or expertise to implement complex machine learning algorithms.
- Impact: May restrict the choice of advanced models or techniques.

4. **Privacy and Ethical Concerns:**
- Constraint: Ethical considerations related to patient data privacy and informed consent.
- Impact: Compliance with ethical standards and regulations may limit data collection and usage.

5. **Interoperability and Integration:**
- Constraint: Integration challenges with existing healthcare systems or laboratory equipment.
- Impact: Difficulty in deploying and utilizing the developed system in real clinical settings.

6. **Hardware Limitations:**

- Constraint: Compatibility issues with the hardware used for capturing X-ray images.
- Impact: Compatibility issues may require additional hardware modifications or adaptations.

7. **Regulatory Compliance:**
- Constraint: Adherence to regulatory standards and approvals for medical devices.
- Impact: Delays in deployment due to the regulatory approval process.

8. **Cost Constraints:**
- Constraint: Budget limitations for hardware, software, and data acquisition.
- Impact: May affect the choice of equipment and resources available for the project.

9. **Time Constraints:**
- Constraint: Project completion within a specific time frame.
- Impact: May require streamlining the development process and trade-offs in terms of model complexity.

10. **Testing and Validation:**
- Constraint: Limited access to Covid-19 testing facilities and medical experts for validation.
- Impact: Validation of the model's accuracy and reliability may be challenging.

11. **Scalability:**
- Constraint: Uncertainty about how the system will handle a surge in testing demands during peak infection periods.
- Impact: May require additional infrastructure planning and scalability measures.

12. **Maintenance and Updates:**
- Constraint: Availability of resources for ongoing system maintenance and updates.
- Impact: The system must remain accurate and up-to-date as Covid-19 evolves and as new data becomes available.

13. **User Interface and Accessibility:**
- Constraint: Ensuring the system is user-friendly and accessible to healthcare professionals.
- Impact: User interface design and accessibility considerations are critical for usability.

14. **Legal and Intellectual Property Considerations:**
- Constraint: Addressing legal issues related to intellectual property, copyrights, and data usage rights.
- Impact: Legal constraints can influence data sharing and project outcomes.

15. **Environmental Impact:**
- Constraint: Minimizing the environmental impact of any hardware or infrastructure used.
- Impact: Sustainability considerations may affect equipment choices and deployment.

2.6 User Documentation

- A user manual will be provided to assist with the setup and use of the system.

2.7 Assumptions and Dependencies

- It is assumed that the system will be connected to a stable internet connection and that a pre-existingdatabase will be provided.

- The image pre-processing and deep-feature extraction are done using the programming language python. So, Google Colab needs to be installed at the developer side.

- Here the assumptions are, the code should be error free and the project should be user-friendly. Libraries used are Numpy, pandas, sk-learn, keras, matplotlib.

3. External Interface Requirements

3.2 User Interfaces

- The system will have a user-friendly interface for setup and use for the user to upload and preview the image.

3.3 Hardware Interfaces

- The system will operate on standard hardware components and will not require specific hardware interfaces., The minimum hardware requirements are 500 MHz CPU and 4GB RAM.

3.4 Software Interfaces

- The system will need to interface with the operating system and any existing systems it is integrated with.

3.5 Communications Interfaces

- This project requires an internet connection to install new plugins, libraries, update already installed ones and update some of its components (APIs, modules etc.)

4. System features

4.1 Upload Image:

Initially, the user uploads the image of lung to detect the Covid-19.When users submit input data, the system preprocesses it and uses the deep learning models to predict the likelihood of Covid, as outlined in the abstract.

4.1 Analyse the Image:

In This module, CNN is used to analyse the image. This feature is of high priority as it involves implementing advanced deep learning models like CNN with optimization Techniques for Covid detection, as described in the abstract.

5.   Performance Requirements

5.1   Functional Requirements

The system shall accept user input data in a structured format, including medical and demographic features relevant to Covid. The system shall implement Convolutional Neural Networks for disease prediction. The system shall provide disease prediction results, including a confidence score indicating the likelihood of Covid.

5.2   Non-Functional Requirements:

Requirements imposed on system Quality are known as Non-Functional Requirements.

- **False Positives and Negatives:** We have different models which produce False Positives and Negatives. Our goal is to reduce false positives and false negatives by implementing three enhancement models on the chest X-ray images.

- **Accuracy:** InceptionV3 reach an accuracy of 97 % and Inception-ResNetV2 reach only an accuracy of 87 % Whereas VGG model can obtain more accuracy.

- **Complexity and Computational Cost:** Both InceptionV3 and ResNet are deep and computationally intensive models. When you fuse them together, the resulting model can become even more complex, which may require significant computational resources for training and inference.

- **Model Compatibility:** ResNet-50, InceptionV3, and VGG have different architectures, which can make it challenging to combine them seamlessly. Ensuring that the features extracted by these models are compatible for fusion may require additional preprocessing or fusion techniques.

- **Overfitting Risk:** The fusion of multiple models may increase the risk of overfitting, particularly when dealing with limited training data.

5.3   Safety Requirements

- The system should not present any safety hazards to users.

5.4   Security Requirements

- The Proposed System does not have any security requirements and thus any type of user can use it without anyadditional privileges.

5.5   Software Quality Attributes

- The Proposed system provides the users with both simple and advanced features. Due to its well designed and   easy to use interface it can be used by People who are infected and also the doctors for further analysis or research.

- **Reliability:** The system should consistently provide accurate disease predictions and minimize errors. Users must rely on the system's predictions for medical decisions.

- **Maintainability:** The system should be maintainable, allowing for updates, bug fixes, and enhancements without significant disruption to user workflows.

- **Portability:** The system should be portable across different environments, including various operating systems and hardware configurations.

5.6   Business Rules

- The system should comply with any relevant business rules or regulations related to its use.