SRS

by Pranav Alle

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Software Requirements and Specifications

Project Name: Minor Project

Aligned SDG: Good Health and well -being (3)

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1. Introduction

The subsections under this section are a brief overview of the Software Requirements and Specifications (SRS) document for the application program titled "Medical Image Analytics for Gastro Disease Diagnosis". The project seeks to create a system that can detect and classify gastro disorders from medical images. Deep learning algorithms will be used to extract features from medical images and classify them into several disease groups. The method will be used to increase the accuracy and efficiency of diagnosing gastro diseases.

1.1 Purpose and Intended Audience

This document provides a software requirements specification (SRS) for above mentioned project. It is prepared for the development team, Medical Professionals, Mentors and Healthcare institutions. Thus serving as a basis for the software design document and outlines the requirements for the application. It is made with the intention of it being:

1.2 Project Scope

- The main goal of this project is to create a medical image analytics tool that can be used to identify gastro diseases. Doctors and other healthcare professionals will utilize this tool to diagnose their patients more quickly and accurately.
- The target audience for this application is doctors and other healthcare professionals who diagnose and treat gastro diseases. The application will be used in hospitals, clinics, and other healthcare settings.

Features

- The ability to use machine learning algorithms to analyze images and identify patterns that are indicative of gastro diseases.
- The ability to generate reports that summarize the findings of the analysis.
- The ability to share reports with other healthcare professionals.

Limitations

- It will only be able to diagnose gastro diseases that can be identified in medical images.
- It will not be able to diagnose all gastro diseases.
- It may not be as accurate as a human doctor in diagnosing gastro diseases.

Future Work

- Improving the accuracy of deep learning algorithms.
- Expanding the application to diagnose more gastro diseases.
- Scaling the application to be used by more healthcare professionals.

1.3 Terms, Definitions, and Acronyms

This document is prepared according to the IEEE SRS Standards and uses technical terminology, different formats of text and abbreviations to provide clarity and distinction to its readability.

- **Terms:**
  a) **Gastrointestinal Disease**: Refers to various disorders and conditions affecting the gastrointestinal tract, including stomach, intestines, and related organs.
  b) **Image Analytics**: The process of extracting useful insights and information from medical images utilizing modern algorithms and methodologies.
  c) **Endoscopy**: A medical treatment in which the interior of the digestive tract is visualized and examined using a thin, flexible tube (endoscope) with a camera attached.
- **Definitions:**
  a) **Gastroenterologist**: A doctor who specializes in the diagnosis and treatment of gastrointestinal problems.
  b) **Image Processing**: Image and sensor data recorded by the capsule prototype are manipulated and analyzed to aid in disease detection.
  c) Image Segmentation: The process of dividing a medical image into distinct regions or segments based on specific attributes, facilitating targeted analysis and interpretation**.**
  d) **Image Classification:** A technique that assigns a label or category to a medical image based on its visual features, enabling the identification of specific patterns or characteristics.

- **Acronyms**: This section contains a collection of acronyms used in the "Medical Image Analytics for Gastro Disease Detection" Software Requirements

Specification (SRS). Each acronym is accompanied by a brief explanation to ensure that technical terms and abbreviations are well understood. These explanations serve as a quick reference guide for stakeholders, allowing them to read the document effectively and comprehend the project-specific language.

1.4 References

- IEEE Recommended Practice for Software Requirements Specifications by IEEE Computer Society (20 October 1998)
  - IEEEXplore-SRS-template.pdf

2. Overall Description

The "Medical Image Analytics for Gastro Disease Detection" initiative aims to advance medical image analysis for the early diagnosis of gastrointestinal disorders. The research intends to improve the precision and accuracy of illness identification by utilizing novel image segmentation and classification algorithms. When these approaches are combined with medical treatments, they provide a thorough view of the gastrointestinal tract. This Software Requirements Specification (SRS) document provides insights into the system's functionality, technical elements, and quality assurance measures.

2.1 Product Features

The system will have the following features:

- **Upload medical images:** Users will be able to upload medical images to the system in JPEG, PNG, and TIFF formats.
- **Analyze medical images:** The system will use artificial intelligence to analyze medical images and identify gastro diseases.
- **Generate a report:** The system will generate a report of the diagnosis results. The report will include the following information:
  - The name of the gastro disease
  - The confidence level of the diagnosis
  - A description of the diagnosis
  - Save the diagnosis results: The system will save the diagnosis results in a database.

2.2 Operating Environment

IDE: An integrated development environment (IDE) can help to streamline the development process for machine learning projects. Popular IDEs for machine

learning include PyCharm, Jupyter notebook, Google Collab

2.3 Assumptions

- The dataset is driven by capsule endoscopy and includes many labeled images. Each image is in the common '.jpg' picture format. But there are some unwanted elements present over main elements.
- The problem-solving approaches that can be used are Image Classification and Image Segmentation.
- The Methodology and Implementation include gathering data, pre-processing data if needed, addressing any encountered challenges (by data augmentation and problem-solving techniques etc.), selecting an appropriate model (such as CNN, RNN, GAN, etc.), and finally conducting model training and evaluation.
- Once all the necessary tasks have been accomplished, our next step involves deploying the solution on platforms like Amazon Web Services (Sagemaker) or Streamlit etc.

3.Specific Requirements

- The patterns in medical images that are suggestive of gastro disease must be precisely recognized by deep learning algorithms.
- The algorithms used in deep learning must be able to generalize new data.
- The algorithms used in deep learning must be effective and comprehensible.

3.1 Functional Requirements

1. **Automated Disease Detection:**
   The system should find and categorize gastro diseases in medical images without human intervention.
2. **Image Format Compatibility:**
   The system should work with various types of medical image formats for flexibility.
3. **Rapid Diagnosis:**
   The system must offer diagnoses within a few minutes for timely patient care.
4. **Disease Differentiation:**
   The system should differentiate between different types of gastro diseases like gastritis, ulcers, and cancer.
5. **Probabilistic Diagnosis:**
   The system should indicate the likelihood of each potential diagnosis, giving a sense of certainty.
6. **Reasoning Explanation:**
   The system should explain the rationale behind each diagnosis for transparency and trust

3.2 Non-Functional Requirements

1. **Image Processing Capacity:**
   The program should handle a significant number of medical images efficiently, enabling quick analysis of images from multiple patients.
2. **Accuracy:**
   The machine learning model's accuracy should be at least 90%, ensuring reliable and trustworthy results.
3. **Efficiency:**
   The program must process medical images swiftly to provide timely results.
4. **User-Friendly Interface**:
   The user interface should be intuitive and user-friendly, especially designed to cater to the needs of radiologists.
5. **Scalability:**
   The program should scale well and handle a large volume of medical images without performance degradation.
6. **Maintainability:**
   The system should be easy to maintain and update, ensuring that improvements and updates can be seamlessly incorporated.

By addressing these points, the medical image processing program can effectively meet the needs of radiologists and healthcare professionals while delivering accurate and efficient results.

3.3 External Interface Requirements

Hardware Requirements

- A computer with a powerful CPU and GPU.
- A large amount of storage space.
- A high-resolution monitor.

Software Requirements

- A programming language such as Python.
- A machine learning library such as TensorFlow or PyTorch.

In addition to the hardware and software requirements listed above, the system will also require a dataset of medical images with ground truth labels for gastro diseases. The dataset should be large enough to train a machine learning model that can accurately identify gastro diseases.

Additional Requirements

The system must also meet the following additional requirements:

- The system must be able to handle images of different sizes and resolutions, noise and artifacts, different levels of contrast, different lighting conditions.

REFERENCES:

1) Digestive Tract abnormalities classification using wireless capsule endoscopy data https://ijisrt.com/assets/upload/files/IJISRT21JUL950.pdf
(Harsh Kumar Modi, Shashwat Mishra, Shashwat Gaur)

2) Impact of quality, type and volume of data used by deep learning models in the analysis of medical images
https://www.sciencedirect.com/science/article/pii/S2352914822000612
(Tudor Florin Ursuleanu , Liliana Gheorghe, Roxana Grigorovici)

3) The Kvasir-Capsule Dataset https://osf.io/dv2ag/ which is referred here

4) A Multi-Class Image-Dataset for Compute Aided Gastrointestinal Disease https://www.kaggle.com/datasets/meetnagadia/kvasir-dataset
(Konstantin Progroelev, Kristin Ranheim Randel, Caarsten Griwodz)

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