Process Descriptions Document (PDD)



**Prepared by Sukru Bora Karakus**

**and Ismail Eza for the Project Classifying MR images and Detecting Tumors using ANN’s in Image Processing, and The Contribution of Ensemble Techniques to Accuracy Rate**

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   1. **Purpose**

This document aims to introduce the purpose and structure of the project, and to comprehensively present its design.

* 1. **Scope**

The document outlines the boundaries and extent of the project, specifying the areas covered and excluded.

* 1. **Background**

The project and its background are briefly introduced.

1. **Project Overview**
   1. **Objectives**

The overall objective of the project is to detect and classify brain tumors from MR (medical imaging) images using artificial neural networks. The project will be considered successful if it achieves a target success rate of >95%.

* 1. **Constraints**
     1. **Time Constraint**

The project is scheduled to be ready for user use by June 2024.

* + 1. **Budget Constraint**

There is no budget constraint for this project.

* + 1. **Resource Constraint**
       1. **Human Resources**

The project team has a certain level of expertise and number of people. The number of team members is not planned to increase during the project.

* + - 1. **Hardware and Software Resources**

People working on the project must have experience in the Python programming language and deep learning libraries. They must also have knowledge of artificial neural network models.

* + 1. **Technology Constraint**
       1. **Programming Languages**

The project will be developed using the Python language. There are no plans to use a different programming language.

* + - 1. **Technological Dependencies**

It is mandatory to stick to the Python language for libraries such as TensorFlow, Numpy, and Matplotlib that will be used in the project.

* + - 1. **Hardware Requirements**

A computer with at least 8 GB of RAM and an Intel i5-generation processor is required.

* + 1. **Scope Constraints**
       1. **Image Type Constraints**

The project will only analyze MR images. Other medical imaging modalities are out of scope for this Project

* + - 1. **Classification Scope**

The project will use deep learning, machine learning, and image processing algorithms for classification.

* + - 1. **User Audience Limitation**

The project is intended for use by healthcare professionals and medical specialists. The use by general users or in a topic outside of the type domain is outside the target audience for this project.

1. **Software Design**
   1. **Overview**

This section will describe the general functionality and objectives of the software design in the project. The software design will focus on the analysis of MR images and will be developed for the purpose of detecting and identifying MR images.

* 1. **Architecture**

The software architecture will be built on a modular, scalable, and extensible structure. Artificial Neural Network architectures that include deep learning algorithms will be used, and Ensemble Techniques will be applied to optimize the algorithms, increasing the accuracy rate by using the performance of the models together.

* 1. **User Interface (UI)**

**A simple interface will be created in Java for this application. Users will be able to use it without difficulty because it is a simple interface to use and understand.**. By creating a simple coding screen where users can easily upload images, the complex codes in the background will not be reflected to the user.

* 1. **Algorithms**

The software uses ANN models to classify MR images. The AlexNET, GoogleNET, and VGGNET models, which are the most popular and functional algorithms/architectures used for image classification, will be used in this project. The highest possible accuracy rate will also be provided by applying Hard Voting and Soft Voting techniques.

* 1. **Programming Languages**

The software will be written using the Python programming language. The Python language will allow us to use TensorFlow, one of the most functional frameworks in the field of deep learning. In addition to TensorFlow, other libraries such as Numpy and Matplotlib will be used and also Java will use for User Interface with JavaFX framework.

* 1. **Data Management**

Data Management will focus on storing, accessing, and processing high-resolution MR images when necessary. Data security and privacy are among the issues to be considered.

1. **Integration Plan**
   1. **Hardware-Software Integration**

The software and hardware integration will use software (such as Python and TensorFlow) that is compatible with the computer being used. Otherwise, the code will not be able to be compiled.

* 1. **Testing**

The testing phases will progress in a planned manner to evaluate the software's correctness and reliability. Our tests will include the following steps:

* + 1. **Unit Tests:** Each model will be tested separately.
    2. **Performance Tests:** The results of each model will be tested separately, and the general metric values of the software after ensemble will be carefully tested and development will continue to achieve the desired values.

1. **Risk Analysis**
   1. **Potential Risks**

The potential risks in this project can be listed as follows:

* + 1. **Data Security Risk**

Violation of the security and privacy of MR images from users or type medical centers (such as hospitals).

* + 1. **Hardware Compatibility**

The hardware selected is not compatible with the software and technology requirements.

* + 1. **Algorithm Performance**

The risk of low accuracy rate due to incompatibility of the developed models and the data set or if the epoch processes are too long or too short (such as over-fitting).

* 1. **Mitigation Strategies**

The following strategies will be implemented to address potential risks:

* + 1. **Data Security Risk**

Increase data security by securely storing data and using protocols. Limit the use of the software by user training and authorization.

* + 1. **Hardware Compatibility**

The use of hardware that has been tested, updated, and approved. Compatibility analysis of the hardware before selection.

* + 1. **Algorithm Performance**

Continuously monitor and update the algorithms. Restart the training of the model if the metrics give abnormal values and test it before moving on to the next stage of the software.

1. **References**

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