

# Capstone Project Concept Note and Implementation Plan

**Project Title: [Alzheimer's Stages Detection App]**

## Team Members

1. [Fatima Amiry]

## Concept Note

### 1. Project Overview

- Provide a brief overview of your capstone project, emphasizing its relevance to one or more Sustainable Development Goals (SDGs).

My capstone project centers on developing an application geared towards early detection and diagnosis of Alzheimer's disease, aligning with the Sustainable Development Goal of Good Health and Well-being. By leveraging technology to enable timely and precise assessments, the application aims to enhance healthcare outcomes and elevate the quality of life for individuals impacted by Alzheimer's.

- Clearly state the problem you aim to address and the potential impact of your solution.

The problem I'm addressing is the late detection of Alzheimer's disease, which hampers effective treatment and care. My solution is a user-friendly app for early screening, aiming to improve patient outcomes and alleviate the burden on healthcare systems.

### 2. Objectives

- Outline the specific objectives of your project.
  - Develop a mobile app for early Alzheimer's screening.
  - Implement accurate cognitive assessment tools.
  - Provide educational resources for users and caregivers.
  - Collaborate with healthcare professionals for reliability.
  - Test rigorously for performance and usability.
  - Launch app on accessible platforms for wide reach.
- What do you aim to achieve, and how will the project contribute to addressing the identified problem?

The aim of the project is to improve early detection and management of Alzheimer's disease. By developing a mobile application with screening tools and educational resources, we hope to empower users and caregivers to identify early signs, access support, and manage the condition effectively. This proactive approach can lead to better health outcomes, improved quality of life for patients, and reduced burden on healthcare systems.

### 3. Background

- Offer a comprehensive background that contextualizes the problem your project seeks to solve.
- Discuss any existing solutions or initiatives related to the issue, and explain why a machine learning approach is beneficial or necessary.

Alzheimer's disease poses a significant challenge to global healthcare systems, with millions affected worldwide. Early detection is crucial for effective management and improved patient outcomes. While traditional diagnostic methods exist, they may be costly, time-consuming, and reliant on subjective assessments. Additionally, machine learning can adapt and evolve with new data, enhancing diagnostic capabilities over time.

Existing initiatives may lack scalability or rely on outdated methodologies. Therefore, a machine learning approach presents an opportunity to develop scalable, cost-effective, and data-driven solutions that can revolutionize Alzheimer's screening and management.

### 4. Methodology

- Explain the machine learning techniques and methodologies you plan to use.
- Highlight any specific algorithms, models, or frameworks that are crucial for the implementation of your project.

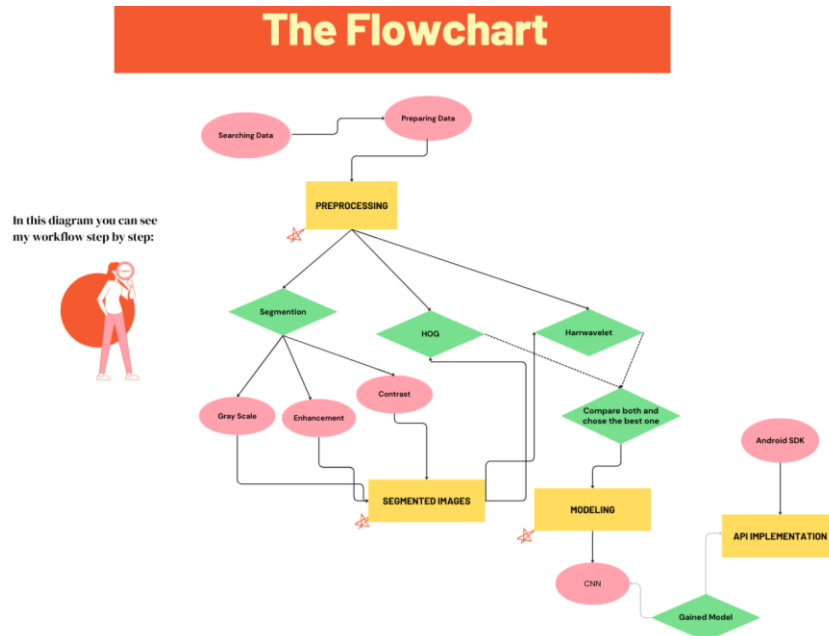
**Preprocessing:** The dataset is prepared through segmentation and preprocessing techniques like HOG and Haar Wavelet Transform to enhance feature extraction.

**Modeling with CNN:** Convolutional Neural Networks are used for image classification, leveraging their ability to capture complex patterns and spatial relationships.

**Implementation:** Anaconda Spyder is chosen as the development environment for its comprehensive tools, facilitating data preprocessing, model training, and evaluation in a user-friendly manner.

## 5. Architecture Design Diagram

- Provide a high-level overview of the architecture of your project.
  - Use a diagram to illustrate the key components and their interactions.
- Briefly describe each component shown in the diagram
  - Highlighting their roles and functionalities within the overall system.



## 6. Data Sources

- Detail the data sources you intend to use for your project.
- Include information about the type of data, its relevance to the problem, and any preprocessing steps required. **(You can use previous data review research but this should be 1 paragraph)**

The architecture consists of an initial input stage, where a dataset of Alzheimer's disease stage images is fed into a preprocessing module. This module employs segmentation, Histogram of Oriented Gradients (HOG), and Haar Wavelet Transform techniques to extract relevant features from the images. Subsequently, a Convolutional Neural Network (CNN) undertakes model training and classification tasks to categorize images into Alzheimer's stages. An evaluation module assesses the model's performance using metrics like accuracy and F1-score, validated through rigorous testing. Anaconda Spyder serves as the development environment, offering essential tools for seamless implementation, training, and evaluation of the CNN model.

## 7. Literature Review

- Summarize relevant literature that supports the methodology and approach you've chosen.
- Highlight key findings from existing research and explain how your project builds upon or extends this work. **(You can use previous literature review research but this should be 1 paragraph)**

## ❖ Literature:

NO	Writers	Preprocessing Methods	Models	Result
1	Swathi & Ketki		DCNN	98.57%
2	<u>Hadeer, Mahmoud &amp; Amira</u>	VGG19	CNN	97%

Both studies propose innovative methodologies for early detection of Alzheimer's disease using deep learning techniques applied to medical image analysis. Abstract 1 employs convolutional neural networks (CNNs) for classification, achieving a high accuracy of 97% [1]. Abstract 2 introduces a deep convolutional neural network (DCNN) approach using MRI samples, attaining an impressive accuracy of 98.57%. Both contributions underscore the significance of early detection in Alzheimer's disease diagnosis, showcasing the potential of deep learning in improving patient care and outcomes [2].

## Implementation Plan

### 1. Technology Stack

- List the technologies and tools you plan to use for the implementation of your project.
  - Including programming languages
  - Libraries
  - Frameworks
  - Any other software or hardware components.

For the implementation of the project, the following technologies, tools, and components will be utilized:

Programming Languages:

- Python
- kotlin

Libraries and Frameworks:

- TensorFlow
- Keras
- OpenCV
- scikit-image
- NumPy
- pandas
- Matplotlib
- Seaborn

Development Environment:

- Anaconda Spyder
- Android SDK

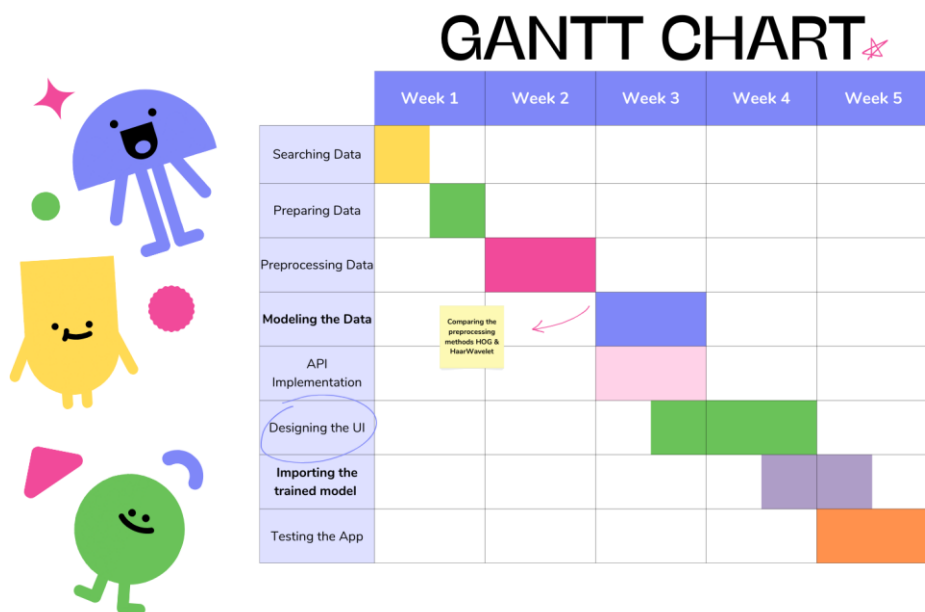
Hardware Components:

- GPU (Graphics Processing Unit) for accelerated deep learning training (optional)

These technologies and tools provide a robust ecosystem for developing and deploying machine learning models for Alzheimer's disease detection.

## 2. Timeline

- Provide a detailed timeline for the different stages of your project,
  - Data collection and preprocessing
  - Model development
  - Training, and evaluation
  - Deployment
- Break down the timeline into manageable tasks with corresponding deadlines. You can use Gantt chart.
  - If you have pair you should add **task distribution matrix** to clarify each members responsibility.



## 3. Milestones

- Identify key milestones in your project's development.
  - These could be related to the completion of specific tasks, the achievement of certain performance metrics, or the successful implementation of key features.

Data Collection and Preprocessing:

- ❖ Collection of Alzheimer's disease image dataset.
- ❖ Preprocessing of images using segmentation, HOG, and Haar Wavelet Transform techniques.

Model Development:

- ❖ Design and implementation of Convolutional Neural Network (CNN) architecture.
- ❖ Training of CNN model using preprocessed image data.

Model Evaluation and Optimization:

- ❖ Evaluation of the trained model using performance metrics such as accuracy, precision, recall, and F1-score.
- ❖ Optimization of the model architecture and hyperparameters for improved performance.

Deployment and Testing:

- ❖ Deployment of the trained model into the mobile application.
- ❖ Testing of the application functionality and performance on different devices.

Validation and Feedback:

- ❖ Validation of the application's effectiveness through user testing and feedback collection.
- ❖ Iterative improvements based on user feedback to enhance the application's usability and accuracy.

Final Deployment and Release:

- ❖ Final deployment of the application to accessible platforms for widespread use.
- ❖ Release of the application to the target audience for early detection of Alzheimer's disease.

#### 4. Challenges and Mitigations

- Anticipate potential challenges that may arise during the project and propose strategies for mitigating them.

- Data quality

Challenge: Ensuring dataset reliability and quality amid noise and biases.

Mitigation: Rigorous preprocessing and expert validation to enhance dataset accuracy.

- Model performance

Challenge: Attaining high accuracy in disease detection.

Mitigation: Experimentation with varied architectures and techniques like transfer learning.

- Technical constraints.

Challenge: Hardware and software limitations.

Mitigation: Optimization, cloud resources utilization, and compatibility assurance

## 5. Ethical Considerations

- Discuss any ethical considerations associated with your project, especially concerning data privacy, bias, and the potential impact on the target community.
  1. Siqi Liu; Sidong Liu; Weidong Cai and etc. Early diagnosis of Alzheimer's diseases with deep learning. (2014)
  2. Swathi S. Kundaram and Ketki C. Pathak Deep Learning-Based Alzheimer Disease Detection