Istanbul Medipol University

School of Engineering and Natural Sciences

Graduation Project

2024-2025

PROJECT TITLE
Artificial Intelligence-Based Diagnosis of Dementia Using Diffusion Tensor Imaging
PROJECT ADVISOR
Prof. Dr. Mehmet Kemal Özdemir
TEAM MEMBERS
Rufeyda Yağcı

Istanbul Medipol University

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Graduation Project

Project Code
Project Title: Artificial Intelligence-Based Diagnosis of Dementia Using Diffusion Tensor Imaging
Project Advisor: Prof. Dr. Mehmet Kemal Özdemir
Project Team Members: (Students need to indicate the group representative/leader) Rufeyda Yağcı
Sponsor Company (if any) :

BUDGET (TL)	PROPOSED	CONSENTED
IMU FUNDING	-	-
SPONSOR COMPANY FUNDING	-	-
TOTAL	-	-

PROJECT PLAN	PROPOSED	CONSENTED
PROJECT PLAN Duration in Weeks	52 weeks	28 Weeks
STARTING DATE	30.09.2024	30.09.2024

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TEAM MEMBER	**Sponsor Company**
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Project Advisor: Prof. Dr. Mehmet Kemal Özdemir
Team Members: Rufeyda Yağcı
Project Group Title:

PROJECT OVERVIEW/SUMMARY/ABSTRACT

Dementia is becoming more prevalent on a daily basis, and not only is it a healthcare issue, but it's also a widespread issue on a global scale with a huge impact on millions of people's lives, placing immense strain on healthcare systems. One of the most troublesome aspects of combating it is its necessity for early diagnosis as well as its types being diagnosed accurately. The problem is many of today's methods are built on predominantly clinical observations and are not always accurate, particularly in its early stages. The initiative sought to build an alternative approach with a combination of sophisticated neuroimaging and machine learning with a view to seeking newer approaches for earlier, more accurate diagnosis of dementia. It was intended to establish a platform with a combination of cerebral imaging, clinical data, and machine learning for early signs of the illness as well as for enhanced diagnosis. From DTI data in the QMIN-MC dataset, the project closely examined white matter tracts—nerve pathways in the brain commonly damaged with dementia. This gave a sharper image of how diseases progress. Interdisciplinarity is what is novel in this project—it brings together state-of-the-art imaging technology with sophisticated AI tools. Region-of-interest analysis was utilized in examining specific parts of the brain damaged with dementia. For prediction and classification, several AI models, including Support Vector Machine, LightGBM, Random Forest, and XGBoost, were implemented using both brain imaging information and clinical information. What is envisioned is a tool that would be capable of providing objective, consistent, and scalable support for dementia diagnosis. To ensure that the project was on course and was yielding meaningful results, some key steps were implemented. First, QMIN-MC dataset was closely analyzed with a view toward finding patterns that would serve as early markers. Neuroimaging data were preprocessed using the Micapipe pipeline in order to ensure clean and standardized input. Diffusion maps were built, voxel-level analyses were performed, and predictions were made via the AI models. The aims weree: find two ACER domains with significant changes, preprocess all imaging data with no problem, generate FA and MD maps, find at least five areas with significant alterations, and achieve model accuracy greater than 80%. The completed model more than exceeded expectations and was 94.44% accurate—quite an indication of just how significant a contribution this integrated AI neuroimaging approach could be in developing dementia diagnostic systems. It may facilitate the early diagnosis of subclinical alterations that remain undetectable to clinicians at the current stage.

Keywords: Diffusion Tensor Imaging (DTI), Alzheimer's Disease (AD), Dementia, Artificial Intelligence (AI), White Matter Integrity