IT4010 – Research Project - 2024

Topic Assessment Form

Project ID: 24-25J-304

1. Topic (12 words max)

Develop a comprehensive system integrating cognitive exercises, AI support, IoT assistance, and big data analytics to manage and potentially halt the progression of Alzheimer's symptoms.

2. Research group the project belongs to

Software Systems & Technologies (SST)

3. Research area the project belongs to

Bio-Medical and Health Informatics (HI)

4. If a continuation of a previous project:

Project ID	
Year	

5. Brief description of the research problem including references (200 – 500 words max) – references not included in word count.

Alzheimer's disease (AD) remains a pressing global health challenge characterized by progressive cognitive decline and memory loss, severely impacting individuals' daily functioning and quality of life. As the most common form of dementia, AD affects millions worldwide, with numbers projected to rise exponentially as populations age. The disease's pathological hallmarks include the accumulation of beta-amyloid plaques and tau protein tangles in the brain, leading to neuronal death and cognitive impairment.

One of the challenges in using cognitive exercises to halt Alzheimer's progression lies in determining the optimal types, frequency, and duration of exercises that effectively promote neuroplasticity and cognitive reserve in patients. Understanding how different cognitive domains (e.g., memory, attention, problem-solving) are affected at different stages of Alzheimer's disease, and which exercises are most beneficial at each stage, is crucial. Additionally, there is a need to establish standardized protocols for cognitive training that can be easily implemented and tailored to individual patient needs (Belleville, 2011) (Clare, 2017).

Developing an AI-powered support system that effectively interacts with Alzheimer's patients requires overcoming several challenges. These include designing AI algorithms capable of natural language processing and understanding, which are essential for meaningful interactions. Moreover, ensuring the system can adapt to the variable cognitive abilities and emotional states of patients poses a significant challenge. Additionally, integrating multimodal communication (text, voice, visual) in a seamless and intuitive manner to cater to diverse user preferences and abilities remains a research priority (Bediou, 2018) (Lee, 2020).

Implementing IoT-based solutions for Alzheimer's care faces challenges such as ensuring the reliability and accuracy of sensors used for activity tracking and location monitoring. The development of robust algorithms capable of interpreting sensor data to detect deviations from normal behavior is critical for timely intervention and patient safety. Moreover, addressing privacy concerns related to data security and ensuring user acceptance and usability of IoT devices in home environments are additional research priorities (Steventon, 2019) (Tsiourti, 2018).

Leveraging big data analytics in Alzheimer's research requires overcoming challenges related to data integration from heterogeneous sources (e.g., medical records, genetic data, lifestyle factors). This includes developing robust data cleaning and normalization techniques to ensure data quality and reliability. Furthermore, implementing advanced machine learning algorithms capable of handling large-scale data to uncover hidden patterns and relationships relevant to Alzheimer's disease pathophysiology and treatment response remains a critical research frontier (Weiner, 2017) (Kori, 2021).

References

Bediou, B. e. a., 2018. A framework for immersive virtual reality training in a virtual supermarket: Rehabilitation tool for patients with Alzheimer's disease.. *Frontiers in Aging Neuroscience,* p. 176.

Belleville, S. e. a., 2011. Cognitive training for persons with mild cognitive impairment: A systematic review and meta-analysis. *Psychological Medicine,* Volume 179-194, p. 41(2).

Clare, L. e. a., 2017. Cognitive rehabilitation and cognitive training for early-stage Alzheimer's disease and vascular dementia. *ochrane Database of Systematic Reviews.*

Kori, A. e. a., 2021. Big data and artificial intelligence in dementia: Opportunities and challenges. Alzheimer's & Dementia. *Translational Research & Clinical Interventions,* p. 7.

Lee, J. H. e. a., 2020. A comprehensive review on Alzheimer's disease: Literature survey and COVID-19 connections. *International Journal of Environmental Research and Public Health,* p. 17.

Steventon, A. e. a., 2019. Effect of telecare on use of health and social care services: Findings from the Whole Systems Demonstrator cluster randomised trial. *Age and Ageing,* p. 48.

Tsiourti, C. e. a., 2018. upporting people with dementia and their caregivers in daily life: A study on designing and assessing an assistive system.. *Journal of Alzheimer's Disease,* p. 64.

Weiner, M. W. e. a., 2017. The Alzheimer's Disease Neuroimaging Initiative: A review of papers published since its inception. *Alzheimer's & Dementia,* p. 17.

6. Brief description of the nature of the solution including a conceptual diagram (250 words max)

The proposed solution integrates cognitive training, IoT, NLP, and big data analytics to manage Alzheimer's disease comprehensively.

1) **Halting the progression of Alzheimer's symptoms through cognitive exercises**.

This solution aims to halt the progression of Alzheimer's symptoms through cognitive exercises delivered via a user-friendly mobile application.

1. User-friendly interfaces: The application will feature interfaces designed to be intuitive and easy to navigate, taking into account the cognitive abilities of Alzheimer's patients. Alzheimer's patients often experience cognitive impairments such as confusion and difficulty with complex tasks. A user-friendly interface reduces frustration and enhances engagement with the cognitive training exercises.

2. Frequent reminders: The app will incorporate a reminder system that prompts users to engage with cognitive exercises at regular intervals throughout the day. Reminders help establish a consistent habit of cognitive training

3. Memory games and riddles: This feature includes a variety of interactive games and riddles specifically designed to stimulate cognitive functions such as memory, attention, problem-solving, and language skills. Examples include matching games, word puzzles, and pattern recognition exercises. Cognitive exercises like memory games and riddles can help slow down cognitive decline by stimulating neural pathways and promoting neuroplasticity.

2.) Enhanced AI-Powered Support System for Alzheimer's Care

This solution provides personalized support through a chatbot utilizing AI to enhance engagement and provide assistance tailored to Alzheimer's patients and caregivers.

1. **Dynamic Conversation Flow:** Based on this analysis, the chatbot adapts its conversation flow to maintain a natural and engaging interaction. For instance, if the user shows a particular interest in discussing sports, the chatbot may continue to bring up related topics or ask more questions about favorite teams or players. If the user responds positively to stories about their childhood, the chatbot might prompt more reminiscing or ask about specific memories.

2. **Multimodal Communication:** The chatbot incorporates both text and voice communication to accommodate different user preferences and abilities, enhancing accessibility and engagement. Voice interaction can be more intuitive for users with limited typing skills.

3. **Cultural and Linguistic Customization:** The chatbot can be customized to accommodate different languages and cultural contexts. This ensures that users from diverse backgrounds can benefit from the chatbot's support in a manner that is respectful and relevant to their cultural norms. For example, the chatbot can use culturally appropriate greetings, references, and conversational styles.

3) IoT-based smart home supportive assistance for Alzheimer's

Utilizes IoT devices to provide automated assistance and monitoring for Alzheimer's patients within their home environment.

1. Reminders: Automated voice reminders for daily activities such as eating, drinking water, taking medication, and Utilizing automation for routine tasks such as medication reminders, scheduling, and environmental adjustments (lighting, temperature). important for elders. who can't properly see.

2.Safety Zones: Creating virtual boundaries to alert carers if the patient wanders beyond safe areas, both indoors and outdoors and Location Tracking Real-time GPS tracking for patients who are prone to wandering, ensuring they can be quickly located.

4) Big Data Analytics for Alzheimer's Research

Harnesses big data analytics to integrate and analyze diverse data sources for Alzheimer's research, aiming to identify risk factors, enable early detection, and personalize treatment plans.

1.Data Collection: Medical Records, Lifestyle Data, Genetic Data, Environmental Factors:

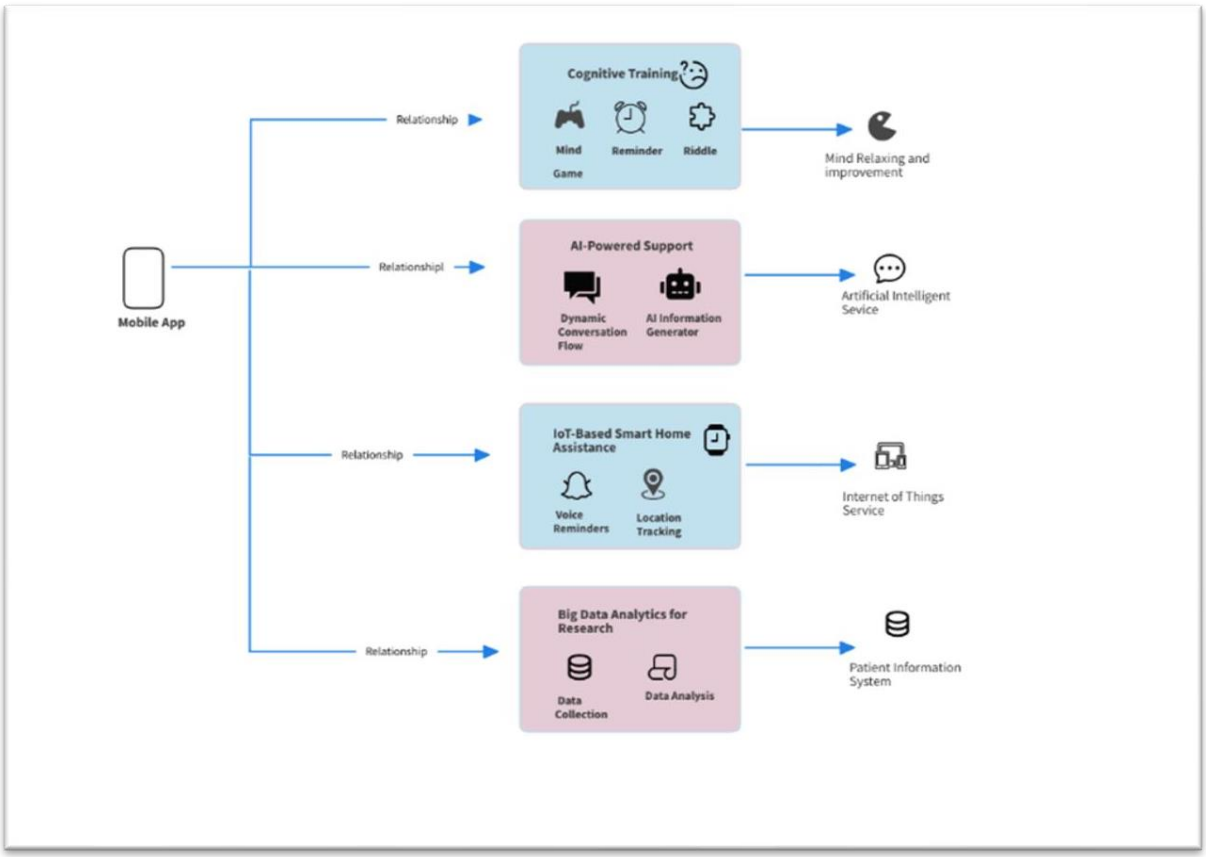
2.Data Integration and Preprocessing: Data Cleaning, Data Normalization, Data Integration,

3.Data Analysis: Descriptive Analytics, Inferential Statistics, Predictive Modelling, Data Mining

4. **Actionable Insights:** Risk Factors Identification, Early Detection, Personalized Treatment Plans:

5. **Advanced Machine Learning Algorithms:** Implementing deep learning techniques such as neural networks to enhance predictive accuracy. Utilizing unsupervised learning to discover unknown subgroups within the data.

Develop a comprehensive system to manage and potentially halt the progression of Alzheimer's symptoms



7. Brief description of specialized domain expertise, knowledge, and data requirements (300 words max)

Successful implementation requires expertise in:

1) **Cognitive Neuroscience and Psychology:** Understanding the cognitive impairments associated with Alzheimer's and designing effective cognitive exercises.

- Data Sources: Clinical Research and Cognitive Training Studies, Patient Data and User Feedback, Neuroscience and Cognitive Psychology Research

2) **Artificial Intelligence and Machine Learning:** Developing AI-powered support systems capable of dynamic conversation flows and personalized recommendations.

- Data Sources: Health and Medical Records, Social Interaction Data, get cognitive Function Data using Neuropsychological Tests (Results from standardized cognitive assessments like the Mini-Mental State Examination (MMSE) and Alzheimer's Disease Assessment Scale (ADAS-Cog))

3) **IoT and Smart Home Technologies:** Implementing IoT solutions for patient safety, activity tracking, and automated reminders.

- Data Sources: Alzheimer’s Disease Research Centers (ADRCs), Patient records, treatment outcomes, and health metrics from hospital databases, Data from ongoing and completed clinical trials focusing on Alzheimer’s care and related technologies.

4) **Big Data Analytics:** Aggregating and analyzing large datasets from medical records, lifestyle information, genetic data, and environmental factors to derive actionable insights.

- Data Sources: Medical Records and Clinical Data, Genetic Data, Imaging Data, Public Health Databases

5) **Healthcare IT Systems:** Knowledge of Electronic Health Records (EHR) systems and Hospital Information Systems (HIS) for integrating patient and staff data.

- Data Sources: Patient medical records, hospital administration systems, patient demographics databases.

6) **User Interface/User Experience (UI/UX) Design:** To create intuitive interfaces for patients, healthcare providers, and administrative staff.

7) **Project Management:** Strong skills to coordinate development, testing, deployment, and maintenance.

8. Objectives and Novelty

Main Objective Develop a comprehensive system integrating cognitive exercises, AI support, IoT assistance, and big data analytics to manage and potentially halt the progression of Alzheimer's symptoms.			
Member Name	Sub Objective	Tasks	Novelty
Mendis A.R.P. IT21228094	Halting the progression of Alzheimer's symptoms through cognitive exercises.	▪ Create user-friendly interfaces ▪ Add frequent reminder ▪ Implement memory games and riddles. Collect patient data from clinical research and cognitive training Studies, Patient Data and User Feedback, Neuroscience and Cognitive Psychology Research .	▪ Innovative and engaging cognitive training programs to promote neuroplasticity.

Bhagya P.S IT21225024	Enhanced AI-Powered Support System for Alzheimer's Care	▪ Develop dynamic Conversation Flow. ▪ Integrate multimodal Communication. ▪ Add cultural and Linguistic Customization. Gather Health and Medical Records, Social Interaction Data, get cognitive Function Data using Neuropsychological Tests (Results from standardized cognitive assessments like the Mini-Mental State Examination (MMSE) and Alzheimer's Disease Assessment Scale (ADAS-Cog))	▪ Adaptive and culturally sensitive AI support enhancing patient engagement.
Sandaruwan W.M.I.M IT21231100	IoT-based smart home supportive assistance for Alzheimer’s	▪ Developed automated voice reminders for daily activities in IOT device. ▪ Made suitable device. ▪ Creating virtual boundaries to alert carers if the patient wanders beyond safe areas. ▪ Location Tracking Real-time GPS tracking Gather data from Alzheimer’s Disease Research Centers (ADRCs) Patient records, treatment outcomes, and health metrics from	▪ Real-time monitoring and caregiver assistance.

		hospital databases, Data from ongoing and completed clinical trials focusing on Alzheimer's care and related technologies.	
Madhusanka J.A. A IT21215292	Big Data Analytics for Alzheimer's Research	▪ Collect data. ▪ Data Integration and Preprocessing. ▪ Data Analysis. ▪ Actionable Insights. ▪ Advanced Machine Learning Algorithms Medical Records and Clinical Data, Genetic Data, Imaging Data, Public Health Databases.	▪ Identifying actionable insights through data analysis

9. Supervisor checklist

a) Does the chosen research topic possess a comprehensive scope suitable for a final-year project?

Yes	X	No	

b) Does the proposed topic exhibit novelty?

Yes	X	No	

c) Do you believe they have the capability to successfully execute the proposed project?

Yes	X	No	

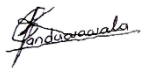
d) Do the proposed sub-objectives reflect the students' areas of specialization?

Yes	X	No	

e) Supervisor's Evaluation and Recommendation for the Research topic:

Approved.

10. Supervisor details

	Title	First Name	Last Name	Signature
Supervisor	Ms.	Uthpala	Samarakoon	
Co-Supervisor	Ms.	Poorna	Panduwawala	
External Supervisor				
Summary of external supervisor’s (if any) experience and expertise				

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Topic Assessment Form

<u>This part is to be filled by the Topic Screening Panel members.</u>

Acceptable: Mark/Select as necessary

Topic Assessment Accepted	
Topic Assessment Accepted with minor changes (should be followed up by the supervisor)*	
Topic Assessment to be Resubmitted with major changes*	
Topic Assessment Rejected. Topic must be changed	

* Detailed comments given below

Comments

The Review Panel Details

Member's Name	Signature

*__Important__:

1. According to the comments given by the panel, make the necessary modifications and get the approval by the **Supervisor** or the **Same Panel**.
2. If the project topic is rejected, identify a new topic, and follow the same procedure until the topic is approved by the assessment panel.