AI base Alzheimer care and Cognitive Support Mobile App.

Project ID: 24-25J 304

Project Proposal Report

IT21228094

Mendis A.R.P.

B.Sc. (Hons) Degree in Information Technology

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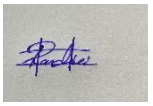
DECLARATION

We declare that this is our own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

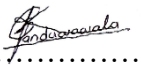
Candidate Name	Student ID	Signature
Mendis A.R.P.	IT21228094	

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

…….

Signature of the supervisor

(Mrs. Uthpala Samarakoon)
23/08/2024



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Signature of the co-Supervisor

(Ms. Poorna Panduwawala)
23/08/2024

Abstract

Through simultaneous integration of touch, aural, and visual sensations, multisensory cognitive training is a novel strategy intended to improve cognitive stimulation in people diagnosed with Alzheimer's disease. By utilizing the brain's innate capacity to interpret and integrate diverse sensory inputs, this approach enhances memory retention and cognitive function. Three essential training games are included in the mobile application covered in this paper: Sound Sequence Recognition, Texture and Sound Matching, and Sound and Color Association. Every game is made to use several sensory modalities and monitor cognitive performance over time using metrics like error frequency, accuracy, and response time. The software may track patterns in cognitive deterioration or improvement and offer tailored workout recommendations based on the needs of each patient by employing predictive analysis. Additionally, a cognitive performance dashboard is included in the system for

Acknowledgement

This is to express my sincere gratitude to you for all of your help and advice when I put together my research proposal. I could not have submitted this proposal without your experience and willingness to share your knowledge.

I would like to express my sincere appreciation to my supervisor Mrs. Uthpala Samarakoon, and co- supervisor Ms. Poorna Panduwawala for their invaluable guidance and support throughout the development of this research proposal. Their expertise and insights have been instrumental in shaping the direction of my study. I am also grateful to the research panel for their constructive feedback and valuable suggestions that have significantly enriched the content and methodology of this proposal. Finally, I would like to thank you again for all of your help and encouragement. As I proceed with this study project, I am looking forward to collaborating with you more.

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LIST OF ABBREVIATION

ML	Machine Learning
WSN	Wireless Sensor Networks
RGB	Red, Green, Blue
API	Application Programming Interface

01. Introduction

Alzheimer's is a progressive neurodegenerative disorder that majorly affects the elderly population and causes gradual declination of cognitive functions related to memory, reasoning, and solving problems. As the population is increasingly aging, Alzheimer's disease cases are going to rapidly increase, hence requiring immediate effective interventions to slow down the progression of cognitive decline and improve quality of life among sufferers.

One of the most innovative ways of dealing with the cognitive challenges precipitated by Alzheimer's disease lies in multisensory cognitive training. The stimulation of several sensory modalities all at once— vision, hearing, touch, etc.—will activate the brain, while the principle of multisensory integration uses this particular ability of the brain to improve memory retention and other cognitive functions. Multisensory cognitive training, by concurrently submitting sensory inputs, may result in a more resilient and full cognitive experience that might delay the progression of Alzheimer's disease.

Traditional cognitive training programs usually focus on single-sensory exercises, for instance, memory games for visual inputs or audio recall tasks. Though these can be very effective, they do not really tap into the multisensory processing capacity that lies innately in the brain. New research has shown that cognitive training programs modulated by activating multiple sensory modalities in patients with Alzheimer's disease could prove to be a more efficient improvement method for cognitive function. The approach derives from studies showing that activation of multiple senses together does better at eliciting superior cognitive outcomes than single-sensory stimulation alone.

It doesn't just stop at memory enhancement; such a kind of multisensory cognitive training might work to enhance other cognitive abilities like attention, speed in processing, and problem-solving. Recent advances in technology permit delivery of the interventions through multisensory cognitive training on mobile applications and other digital platforms, hence offering these interventions to a larger population of patients and carers.

This introductory piece rationalizes how, and with what benefits, multisensory cognitive training can be integrated into the treatment of Alzheimer's disease, thereby setting a basis for a more elaborate review of the background, literature, and methodologies that support it.

1.1 Background and Literature Survey

Alzheimer's disease is a neurodegenerative disorder and one of the most common causes of dementia in elderly people. It is characterized by progressive cognitive decline, affecting memory, language, and reasoning abilities. With the aging populations in most countries, Alzheimer's is likely to increase in prevalence and eventually turn into a big challenge to public health. Conventional treatment methods have been basically pharmacological with small effectiveness in stopping disease progression. This makes non- pharmacological interventions, such as cognitive training, to support cognitive function and slow down the progression of AD, more interesting.

One of the most bright methods in cognitive training is multisensory cognitive training. This technique makes use of the inherent ability of the brain to process and integrate information from multiple sensory modalities, such as vision, hearing, and touch, to stimulate the cognitive process. The underpinning concept of this approach is one of multisensory integration, that is, relating to the brain's ability to combine inputs from different senses. It has been demonstrated that the more senses activated simultaneously, the greater the potential enhancement of the brain's ability to encode, store, and then retrieve information could be, thus leading to better cognitive outcomes. **[1]**

Such multisensory cognitive training is particularly relevant for AD patients because it simply offers a more holistic concept than these traditional single-sensory cognitive exercises. On the other hand, traditional concepts for training often make use of visual and, to a limited extent, also auditory stimuli. Probably independent of the status of the disease, this type of demand cannot fully activate the multisensory potential of the brain. In contrast, multisensory cognitive training aims to excite multiple sensory pathways simultaneously in order to achieve better cognitive performance and slower progress of the disease. **[2]**

1.2 Research Gap

[2] [3] [4]

Feature	Research 01	Research 02	Research 03	Research 04	Proposed System
Multisensory Integration	✓	✓	✓	✓	✓
Predictive Analytics	✕	✓	✕	✕	✓
Personalized Exercise Recommendations	✕	✓	✕	✕	✓
User-Friendly Mobile Application	✕	✕	✕	✕	✓
Cognitive Decline Tracking	✕	✕	✕	✓	✓
Alerts & Reports to Caregivers	✕	✕	✕	✓	✓

Figure 1 Research Gap

1.3 Research Problem

A progressive neurological illness that mostly impairs memory and cognitive abilities is called Alzheimer's disease. There has been some evidence that Alzheimer's patients' cognitive deterioration can be slowed down by traditional cognitive training regimens. However, instead of integrating many sensory inputs, these systems frequently use unimodal techniques that concentrate on a single sensory modality (such as visual or aural). Furthermore, predictive analytics and tailored intervention techniques that adjust to the patient's evolving cognitive needs are absent from the current cognitive training apps.

Unimodal Approaches: The vast majority of contemporary cognitive training techniques do not avail themselves of the possible benefits stemming from multisensory stimulation, which would enhance memory retention and overall brain performance by involving multiple sensory pathways simultaneously.

Lack of Predictive Analytics: It is without the application of predictive analysis tools to trace cognitive performance over time and adjust in real-time the level of difficulty or type of cognitive exercises to the actual needs of a patient.

Inadequate Personalization: Most of the systems lack in providing recommendations or automatically making changes that would help address the unique progression of cognitive decline in a particular patient.

Insufficient Caregiver Support: Most of the existing applications make very little attempt to keep the caregivers informed through alerts, detailed reports, and actionable insights into the changes in a patient's cognition.

02. Objectives

2.2 Main Objective

Creating and validating a comprehensive multimodal cognitive training system for Alzheimer's patients is the primary goal of this project. With the integration of visual, aural, and tactile inputs, this system will create a mobile application that is augmented with real-time caregiver notifications, tailored cognitive exercise recommendations, and predictive analytics. The ultimate objective is to enhance patient outcomes and lessen the burden on caregivers by tracking cognitive decline, improving cognitive stimulation, and offering customized therapies.

2.2 Specific Objectives

- Create Multimodal Cognitive Games: To improve cognitive stimulation for individuals with Alzheimer's disease, create and execute cognitive training games that incorporate touch, visual, and aural stimuli.
- Use Predictive Analytics: Put machine learning algorithms to use in analyzing user data, monitoring cognitive function, and forecasting changes in cognitive abilities over time.
- Customize Cognitive Interventions: Develop a system that suggests workouts to users according to their cognitive abilities and modifies the degree of difficulty to suit their requirements.
- Enable Caregiver alarms and Reporting: Create a function that, in response to notable cognitive shifts, sends out real-time alarms and produces comprehensive reports for caregivers and medical experts.

2.2.1 User Requirements

Three main categories can be used to categorize the user needs for the "Texture and Sound Matching" mobile application for Alzheimer's patients: functional requirements, non-functional requirements, and user interface requirements.

2.2.2 Functional Requirements

- Texture and Sound Matching Game:
    - The application will display a variety of textures on the screen that can be felt using haptic feedback simulation.
    - Users will be able to swipe or tap the screen to match particular sounds with these textures using this app.
    - If the chosen texture and sound were not matched well, the program will provide you instant feedback.
- Simulated Haptic Feedback:
    - The app shall simulate different textures using vibration patterns to represent various textures (e.g., rough, smooth, soft).
    - The app shall adjust the intensity and frequency of vibration to accurately simulate different textures.
- Sound Pairing and Feedback:
    - The app shall include a variety of sounds that correspond to the textures presented.
    - The app shall play the paired sound upon user interaction, providing auditory feedback.
- Cognitive Performance Tracking:
    - The app shall track the user's response time and accuracy in matching textures and sounds.
    - The app shall store historical data on the user's performance for trend analysis
- Predictive Analysis and Recommendations:
    - The app shall analyze the user's performance data over time to identify trends in cognitive decline or improvement.
    - The app shall provide recommendations based on the analysis, such as suggesting more frequent sessions or easier exercises if a cognitive decline is detected.
- User Profiles:
    - The app shall allow for multiple user profiles to accommodate different patients.

- Each user profile shall store personalized data, including performance history and recommended settings.

2.2.3 Non-Functional Requirements

Performance:

- The app shall have minimal latency in providing haptic feedback and sound responses.
- The app shall perform predictive analysis without significant delays.

Usability:

- The app shall be easy to use, with a simple and intuitive interface suitable for elderly users with cognitive impairments.
- The app shall include accessibility features, such as large buttons, clear text, and voice guidance, to assist users with varying levels of cognitive ability.

Security:

- The app shall ensure that user data, including performance history and personal information, is securely stored and transmitted.
- The app shall comply with relevant data protection regulations (e.g., GDPR, HIPAA).

Reliability:

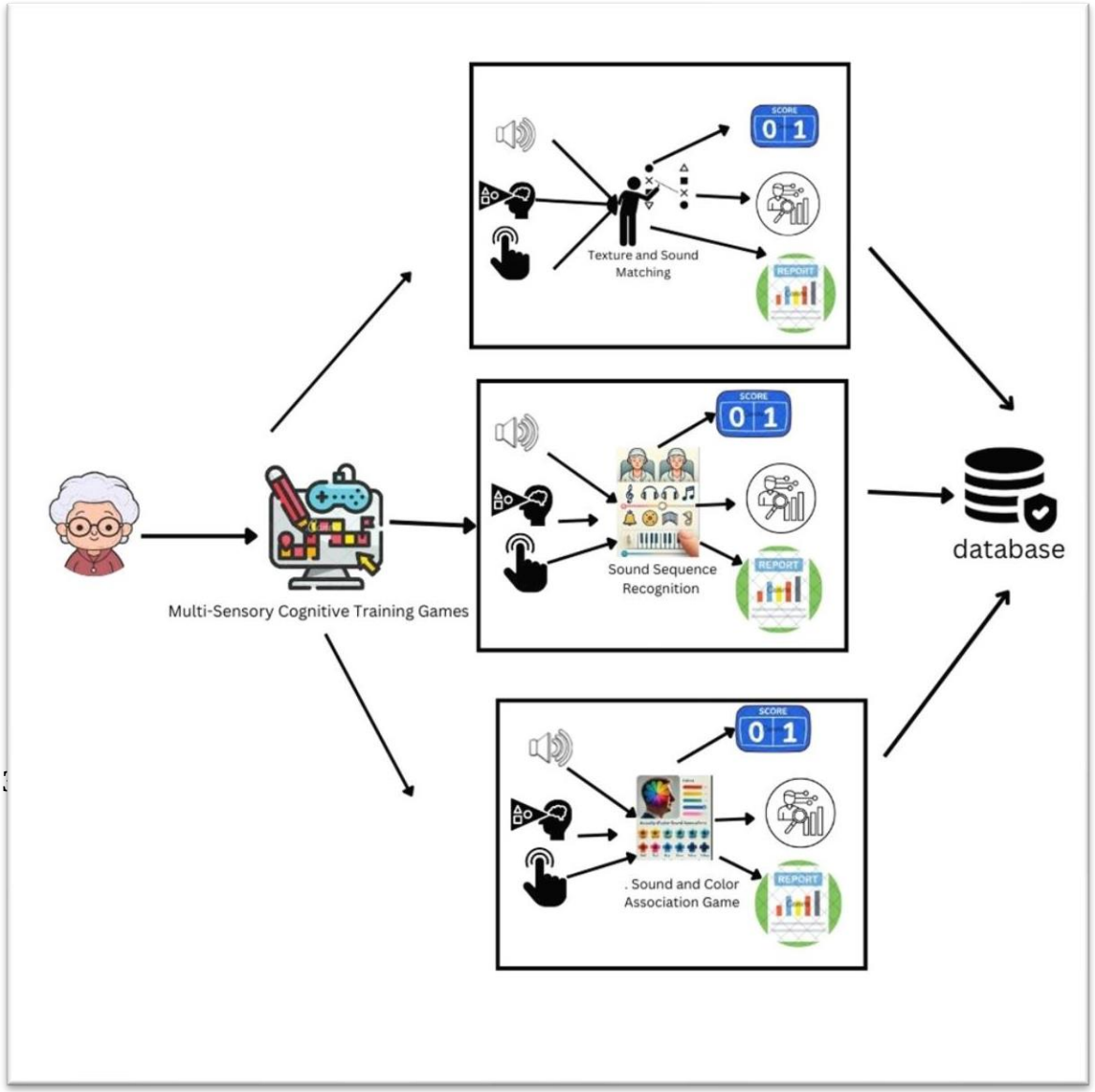
- The app shall be reliable, with a low rate of crashes or bugs.
- The app shall be available for use 99.9% of the time, ensuring consistent access for users.

Compatibility:

- The app shall be compatible with both Android and iOS devices.
- The app shall support a range of devices with different screen sizes and hardware capabilities.

03. Methodology

3.1 System Architecture



3.2 System Technology

1. Machine Learning - to analyze car features and classify them into different models.

2. Notification and Alert - The system will use real-time notification techniques to inform users.

3. Data Management and Security - to gather data from various sources to improve the accuracy of the classification system.

Programming Languages

- Python
- React Native or Flutter/Dart
- JavaScript
- HTML/CSS

Tools

1. TensorFlow - an open-source software library for dataflow and differentiable programming across a range of tasks.
2. Visual Studio Code - A lightweight and adaptable code editor that supports a variety of programming languages and frameworks. It's great for building using React Native or Flutter.
3. Android Studio - The official IDE for Android development, which also works with Flutter. It includes comprehensive tools for designing, testing, and debugging Android applications.
4. Figma - A cloud-based design tool for UI/UX design that facilitates cooperation between designers and developers. It's perfect for developing prototypes and wireframes for mobile apps.
5. Firebase - Firebase offers a full suite of mobile app development capabilities, including authentication, real-time databases, cloud storage, and hosting.
6. Firebase Test Lab - Firebase provides a cloud-based application testing environment. It allows you to test your app across a variety of devices and setups.
7. GitHub - Platforms for hosting Git repositories that include tools for continuous integration (CI), problem tracking, and collaboration.
8. Firebase Cloud Message - FCM is a cross-platform messaging solution that lets you deliver notifications and messages to users on Android, iOS, and web apps.

04. Gantt Chart

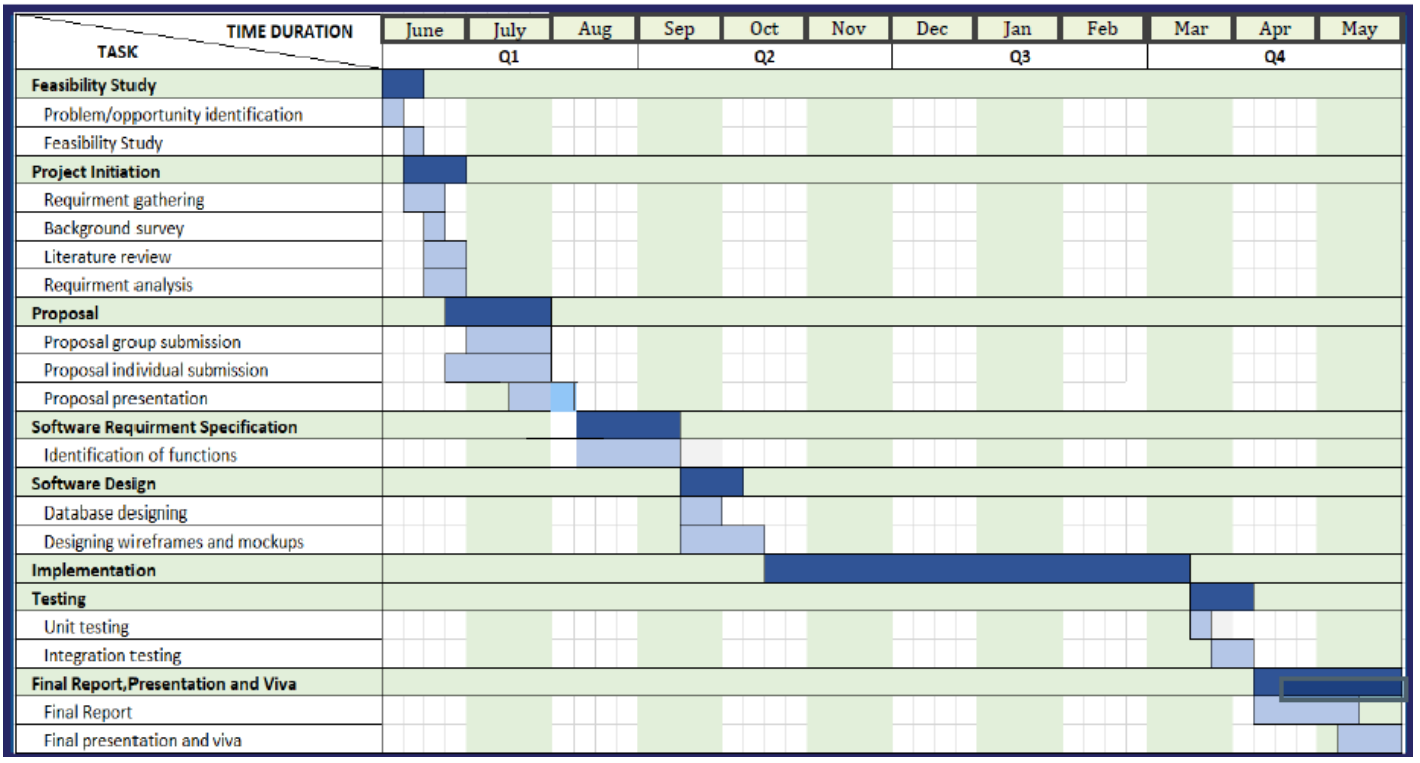


Figure 3 Gantt Chart

05. Work Breakdown Structure

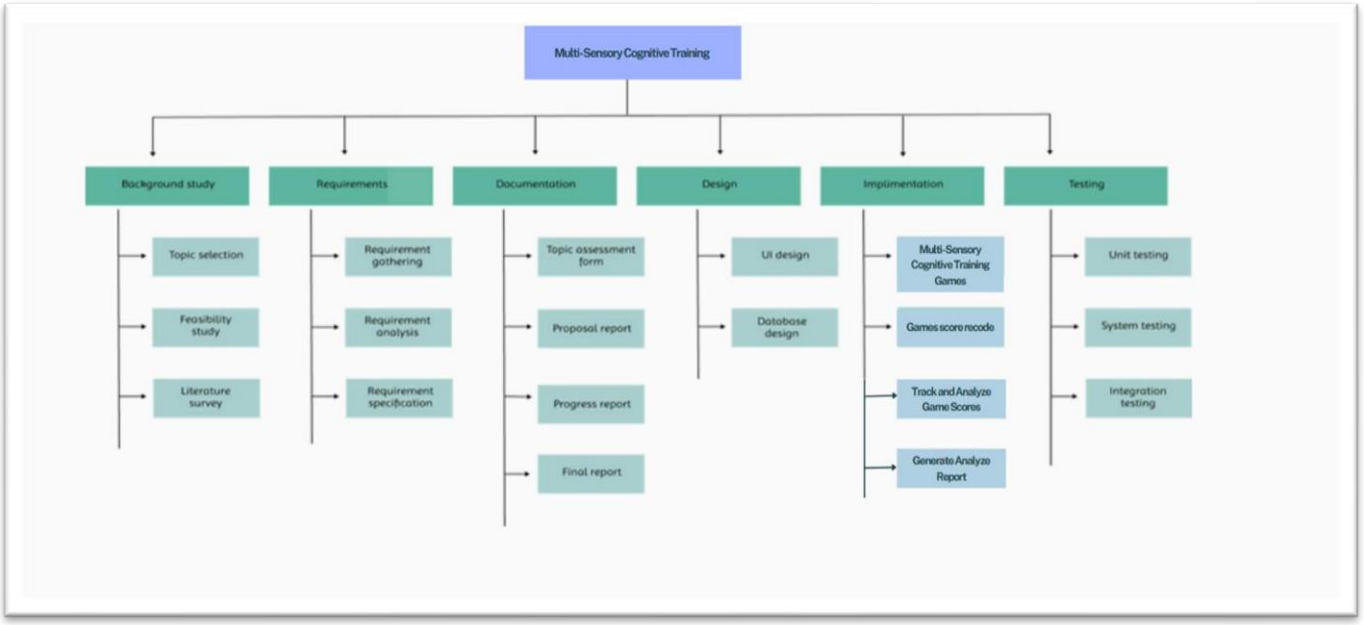


Figure 4 Work Breakdown Structure

06. Commercialization

Commercializing an AI-powered Alzheimer's care and cognitive support mobile app requires a multifaceted approach that includes market entrance tactics, pricing models, collaborations, and scaling initiatives. This is a breakdown of the commercialization strategy.

1. Target Market: Alzheimer's patients, caregivers, and clinicians.

2. Pricing Model: In Basic Plan It has innovative features such as personalized learning routes, AI- powered emotional support, and real-time feedback. Targeted for major healthcare organizations and institutes.

3. Distribution Channel: Launch the app on key platforms such as Google Play and the Apple App Store.

4. Marketing and Promotion: Raising awareness can be accomplished through internet commercials, social media campaigns, and content marketing.

07. Budget

Description of Tasks	Estimated
1. Clod Infranstructure	Rs. 8000
2. Internet Charges	Rs. 5000
3. Travelling Cost for Information Collection	Rs. 10000
4. Data gathering	Rs. 10000
Total	**33000**

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