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AI-Based Memory Palace Generator with Mind-Map Integration

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Abstract: Learning and memorizing can feel like a slog, especially when there's nothing interactive or visual to help things stick. That's where the AI-Based Memory Palace Generator with Mind-Map Integration steps in. This project aims to make learning not just easier, but actually interesting. Here's how it works: you type in your topic or paste in some text, and the system feeds that into the OpenAI model. It pulls out the key points, breaks things down into subtopics, and automatically builds an interactive mind map. Each node stands for a single concept. When you click on a node, you get a quick explanation just enough to help you grasp the idea without getting bogged down. But it doesn't stop there. The tool also creates a two-dimensional memory palace video, placing each concept inside a virtual space so it's easier to remember later. The prototype uses ReactJS on the front end, OpenAI to handle the language processing, and Supabase for storing everything in the backend. Right now, it does a great job generating mind maps and some visual elements, opening up fresh ways for people to learn and remember things better.
Keywords: Artificial Intelligence (AI); Mind Map; Memory Palace; Cognitive Learning; Visualization;

I. INTRODUCTION

Learning and memorization are big parts of both school and work, but let's be honest old-school methods like reading textbooks or jotting down notes rarely help you remember the really big or tricky stuff. That's why more people are moving away from those traditional tools and looking for something more visual. Enter mind maps and the memory palace technique—two strategies that actually make information stick. A mind map is pretty simple: you start with a main idea in the center and branch out to related topics. This way, you see how everything connects, and it just makes things click. The memory palace, or method of loci, goes a step further. Here, you picture a place you know well and mentally put pieces of information in different spots. Later, when you walk through that place in your mind, the details are right where you left them. These techniques work even better when you throw AI into the mix. That's where the "AI-Based Memory Palace Generator with Mind-Map Integration" comes in. Using artificial intelligence specifically, the OpenAI model it takes whatever text or topic you give it, pulls out the key points, and builds an interactive mind map for you. On top of that, it turns each main idea into a virtual space inside a memory palace, so you can store everything in a way your brain loves. The main goal here? Make tough subjects easier to understand and way easier to memorize, all thanks to AI-powered visuals.

II. LITRATURE REVIEW

1. Luo and colleagues took a close look at how AI is changing higher education. They found that modern AI tools don't just speed up learning they also give students instant feedback and tailor content based on individual needs, no matter the subject. Visualization and recommendation features stood out, making it easier for students to really engage with the material.

2. Gotavade introduced a modular AI setup that crafts custom learning paths and interactive materials using natural language processing and visual tools. His system even builds mind maps and 3D aids. What's cool is that it helps people learn even if they don't know much about programming or teaching so more folks can access quality education.
3. Jabade and Nadaf tested mind maps with nursing students and saw real benefits. Students remembered information better in the short term, understood concepts more clearly, and felt more engaged. Plus, they didn't feel as mentally drained compared to when they just took regular notes.
4. Sankarapandian's team rolled out the INFINITI mind mapping model in a randomized study. The results? Students scored almost 18% higher on their exams and felt less academic stress. Structured mind maps clearly helped them understand and remember course material.
5. Kefalis and colleagues sifted through over 50 studies on mind maps in STEM classes. They found that these visual frameworks help students grasp tough concepts, learn step-by-step processes, and take more control of their own learning especially in science and engineering.
6. Twomey and Kroneisen looked at 13 experiments on the method of loci and found that it really boosts memory recall (with a solid effect size of g=0.65). The trick seems to be organizing information in space and using strong visual links.
7. Moll and Sykes took things further by putting the method of loci into virtual reality. People who used these immersive "memory palaces" remembered 20–22% more than those who didn't. The study makes a strong case for immersive visualization as a way to sharpen memory.
8. Rosello built an augmented reality app that lets people use the method of loci in real-world settings. His prototype nearly tripled long-term recall accuracy, showing that AR could be a powerful tool for learning and memorization.
9. Huttner and team studied how people behave in virtual memory palaces. Interestingly, even users who didn't know about the loci method still learned better by placing objects along virtual paths. Just being exposed to a spatial layout seemed to help with learning.
10. Strielkowski and colleagues talked about how AI-driven systems can personalize learning for everyone. By using smart monitoring, instant feedback, and custom-made curricula, these systems help create more inclusive and scalable education for diverse groups of students.
11. M.Zerkouk and the team took a deep dive into AI-powered intelligent tutoring systems. These systems act a lot like human tutors, shaping the learning experience for each student. Their review really focused on how these tools can scale, their success in teaching STEM subjects, and how they weave in natural language processing to make things smoother.
12. E.Krokos and A. Varshney showed something interesting: people who wandered through virtual memory palaces in VR remembered way more details than those who just used desktop versions. Basically, when you're fully immersed in a space, your brain holds onto information better and for longer.
13. A.Vetter and colleagues rolled out a VR learning game that lets you build your own memory palace from scratch. The system gives you tools for placing symbols and interacting with them in real time, which helps you tie abstract ideas to concrete images and spaces.

Year	Author	Methodology	Technic / Module Used
2025	J.Luo et al.	Systematic Review	AI-based tools in education (adaptive learning, tutoring, analytics)
2024	T.S.Gotavade	System Architecture Proposal	AI ecosystems with mind maps, NLP, 3D visualizations
2024	M.Jabade & H.Nadaf	Comparative Study	Mind mapping vs. traditional notes in nursing education
2025	C. Sankarapandian et al.	Randomized Controlled Trial	INFINITI mind-mapping model for stress reduction and performance
2025	C. Kefalis et al.	Systematic Review	Mind maps in STEM, procedural learning support
2021	C.Twomey & M.Kroneisen	Meta-analysis (13 studies)	Method of Loci (MoL) – recall performance effect size (g = 0.65)
2022	B.Moll & E.Sykes	Experimental Feasibility Study	VR-based immersive memory palaces for improved retention
2017	O.Rosello	Prototype Design and User Testing	AR-based method of loci app (NeverMind)
2019	J.P.Huttner et al.	User Behavior Study	Virtual memory palace with implicit loci awareness
2025	W.Strielkowski et al.	Case Analysis	AI-driven adaptive learning for curriculum transformation
2025	M.Zerkouk et al.	Literature Review	Intelligent tutoring systems with AI and NLP
2019	E Krokos& A. Varshney	Controlled Experiment	Immersive vs. desktop memory palace effectiveness
2020	A.Vetter et al.	Technical Demonstration	"The Art of Loci" VR game for memory

			construction

III. METHODOLOGY

This system's an AI-driven web app that helps you learn and remember information by turning any topic or text into interactive mind maps and memory palace visuals. It blends natural language processing, data visualization, and classic memory tricks to make learning feel personal and genuinely engaging.

A. System Overview

The setup runs on a modular design and moves through four main stages:
1. Input Processing
2. AI Analysis
3. Mind Map and Memory Palace Creation
4. Data Storage and Retrieval

ReactJS powers the frontend, while OpenAI's APIs handle text analysis and content generation.

B. User Input and Topic Extraction

You start by typing in a topic or pasting some text. The app sends this to OpenAI, which pulls out the main ideas, definitions, and how things connect. If you give it something broad say, "Photosynthesis" the system breaks it down into smaller pieces like "Light Reactions" and "Calvin Cycle."

C. Mind-Map Generation

The AI organizes everything into a branching tree:
Your main topic sits in the center.
Subtopics branch out as "child" nodes.
You can add extra layers for definitions or related ideas.
A ReactJS canvas brings this to life, laying it all out in a radial pattern. Every node's interactive. Hover over one, and you'll see a quick, AI-written explanation—just enough to jog your memory.

D. Memory Palace Representation

To lock things into your memory, the system creates a 2D "memory palace" think animated rooms or paths, with objects representing each concept (like a crown for monarchy). The AI picks the symbols, lays them out in order, and writes a script and narration for the video. Right now, it's just a static image preview (since video rendering isn't done yet), but that's on the roadmap.

E. System Architecture

Here's how it all fits together:
Frontend: ReactJS handles the visuals, mind maps, and video popups.
AI Engine: OpenAI does the heavy lifting—NLP, content, and video scripts.
Backend: Stores everything from user inputs to media links and session data.

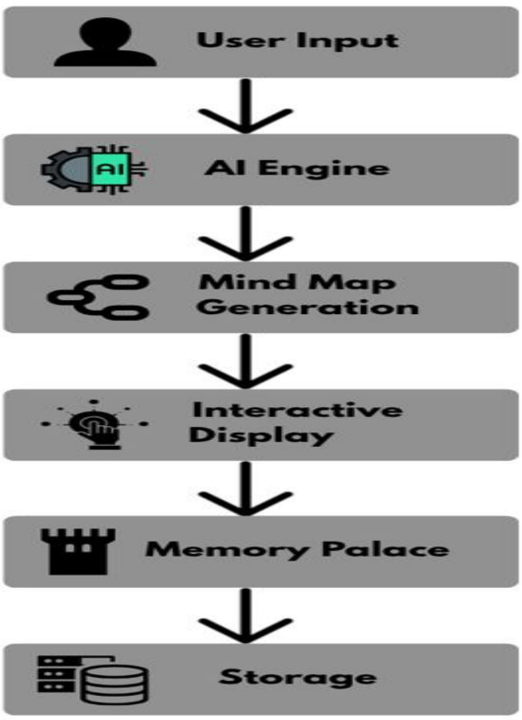

Fig. 1 System Architecture and flow diagram

F. Workflow Summary

Here's how it works. First, you enter a topic or some text. OpenAI jumps in, breaks it down, and pulls out the key ideas. The system builds a mind map around those concepts and shows it to you—each node pops up with a definition when you hover over it. If you click on a node, the system creates a memory palace image tied to that idea (there's a plan to add video later). Supabase quietly saves everything behind the scenes—your session, the mind map, results, all of it.

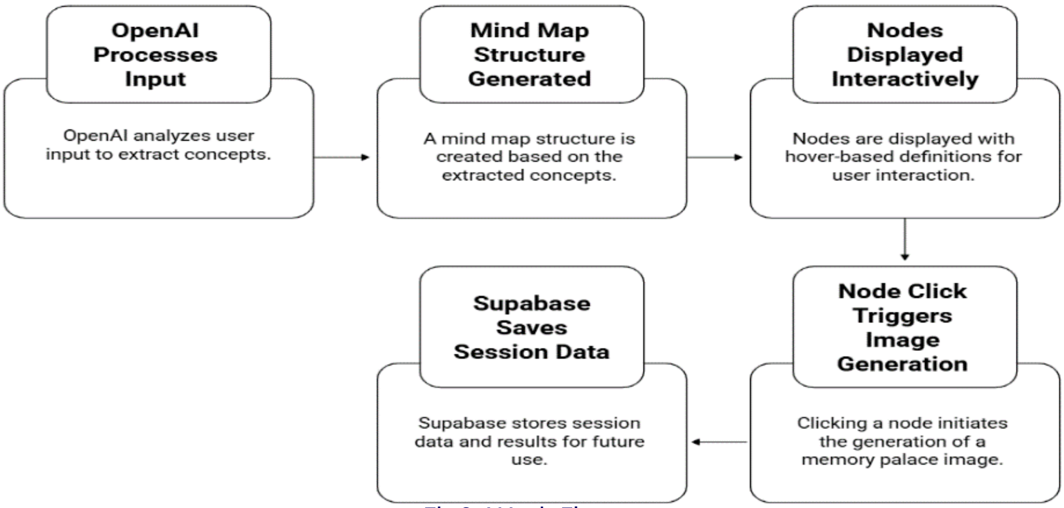

Fig.2. Work-Flow

This setup lets you actually see how complex topics connect and makes them way easier to remember, since you're tying together both where things are on the map and what they mean

IV. IMPLEMENTATION

We built a working web prototype using mostly low-code tools. The whole point was to prove you can get real value from AI for content breakdown, visualization, and memory tricks, even if you're not a hardcore programmer.

A. Technology Stack:

Here's what's under the hood:

Frontend: ReactJS powers the interface. It handles what you type in, draws the mind map, and controls all those interactive pop-ups and media bits.

AI Engine: The OpenAI API does the heavy lifting analyzing your input, finding subtopics, writing quick definitions, and drafting scripts for the memory palace images.

Backend & Storage: Supabase keeps track of everything your entries, mind map data, images and videos, session details. It's also where all media gets stored, safe and sound.

B. Mind Map Visualization:

The mind map comes together as a radial tree using libraries that play nicely with React. Your main topic sits in the center, with branches for each subtopic and their definitions. Some highlights: - You can hover over any node to see a short AI-generated explanation. Each level has its own color, so you don't get lost. - The whole thing stretches or shrinks to fit whatever topic you throw at it small or huge.

C. Memory Palace Output:

Right now, the system turns concepts into a static image, not a full-on animated video (at least, not yet). It maps ideas onto objects inside a visual "room," so you see how the pieces fit together. - The scene shows a symbolic space where each object stands for a subtopic. - AI picks out and places these objects for you. - Down the road, we plan to add animated videos and automatic voice-overs, either with AI tools or third-party platforms.

D. Session Management and Data Persistence:

Every session gets its own unique ID no login needed. The system saves your input, the mind map structureand any media it generates. Later, you can find all your past work in the "My Projects" section, so you can pick up where you left off or review older stuff.

V. RESULTS AND DISCUSSIONS

We put the prototype through its paces with different academic topics to see how well it could turn complex ideas into clear visuals you can actually remember. Since this is just the first version, we mainly focused on how well the mind map works, how fast you get info from hovering, and how the memory palace images look.

A. Test Topics and Output Evaluation

We tried out things like:

Photosynthesis (Science)
French Revolution (History)
Human Digestive System (Biology)
Object-Oriented Programming (Computer Science)

For each topic, the system pulled out 4–7 solid subtopics, labeled everything clearly, and popped up definitions within a second or two when you hovered. The mind maps looked neat and made sense, especially for subjects with a clear hierarchy, like biology and history.

B. Memory-Palace Evaluation

For now, the memory palace is just a static image, but it does a good job mapping each concept to a visual object in a virtual room. For example, the "French Revolution" scene showed a crown for monarchy, a guillotine for the Reign of Terror, and a flag for liberty. People said this kind of visual storytelling stuck with them way better than just reading plain text. What's missing? Real animation and voice narration, both coming in future updates.

C. System Responsiveness and Usability

Mind map generates in under 3 seconds on most browsers. - OpenAI processing takes 2–6 seconds, depending on what you type in.

People on the team found the interface easy to use, even without any tech background.

It works well on both desktop and mobile, so the layout and performance check out.

D. Observed Challenges

Sometimes, when the topic got a bit long, the AI lumped together subtopics that didn't really belong in the same group. Video generation didn't work out either, since the backend couldn't render videos, so it just fell back to showing a static image instead. And when mind maps had more than ten branches, the whole thing started to look messy on the screen so features like zoom or collapse would really help clean things up.

E. Summary

The system shows it can pull out the main structure of a topic, create a meaningful visual, and help people remember things using spatial storytelling. Mind mapping works well and keeps the learning process interesting. The memory palace output is still just a static image right now, but it lays the groundwork for a visual, AI-powered way to boost memory.

VI. CONCULSION AND FUTURE WORK

This project built an AI system that makes learning and memorization easier by automatically turning topics into mind maps and visual memory palaces. With OpenAI's language processing behind the scenes, a ReactJS interface, and a Supabase backend, users can turn simple topics into organized, visual study tools no technical know-how needed. The mind map tool gives a clear, interactive look at any topic's structure. The symbolic memory palace adds another layer, helping people remember what they learn for longer. Tests with different topics proved the system pulls out and shows the key information pretty accurately. Sure, the memory palace is just a static image for now, but it's enough to show how visual storytelling can work in education. Next up, the plan is to: • Add full 2D animation with audio narration to the memory palaces • Give users accounts to help manage their projects • Let people customize mind maps and use more languages • Add zoom and collapse features for big, complicated maps • Look into AR and VR so memory palaces feel even more real This system sets the stage for smarter, AI-powered learning tools and shows how anyone even folks who aren't programmers—can use modern AI to create powerful educational solutions.

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