AI TOWN - EAGLE GROVE

Kotian, Shivani
California State University, Los Angeles
skotian@calstatela.edu

Punabaka, Muni Vignitha
California State University, Los Angeles
mpunaba@calstatela.edu

Barns, Monisha
California State University, Los Angeles
mbarns@calstatela.edu

Patel, Nandini Vijaybhai
California State University, Los Angeles
First line of institution2 address
npatel121@calstatela.edu

Patel, Helly Dilipbhai
California State University, Los Angeles
hpatel86@calstatela.edu

Abstract

This paper introduces "Generative Agents," a concept that involves computational software agents simulating human-like behavior. These agents perform everyday activities and interact in a simulated environment, creating a believable representation of human life. The study's core innovation is an architecture that enables these agents to store, synthesize, and dynamically retrieve memories, thus planning and adapting their behavior. This architecture incorporates a large language model and is demonstrated in a sandbox environment inspired by games like The Sims. The agents show individual and social behaviors, autonomously organizing events and forming relationships, reflecting the complexity and spontaneity of human interactions.

1. Introduction/Background/Motivation

We aimed to enhance a virtual simulation by replicating an existing framework, incorporating personalized characters that resemble our team members. This involved creating unique identities for these characters, making the simulation more relatable and customized. This project is inspired by the Standford Town. [1] Currently, simulations are often built using predefined models and characters. These characters usually follow a standard set of behaviors and interactions, determined by the simulation's programming. This approach, while efficient, has its limitations. The characters lack the depth and individuality found in real people, leading to a more generic and less engaging experience. The dynamics and unpredictability of human-like behavior are often not fully captured, resulting in a simulation that can feel artificial and less immersive. The inability to deeply personalize these characters or scenarios restricts the potential for simulations to mirror real-world complexities and nuances. If successful, this personalized approach to simulation will offer a more immersive and relatable experience. It can enhance user engagement by reflecting real-world diversity and individuality, making the virtual environment more meaningful and relevant to users. The paper focuses on the creation of "Generative Agents," a novel approach in interactive simulations. These agents are designed to mimic human-like behavior in a simulated environment, demonstrating individual and social behaviors that are dynamic and believable. This advancement in simulation technology could significantly impact various fields, from gaming and virtual training environments to social science research. If successful, it could lead to more immersive, realistic, and engaging simulations that better reflect human behavior and social interactions, providing a valuable tool for both entertainment and scientific study.

2. Approach

The approach taken in the paper involved creating an interactive simulation using "Generative Agents," which are AI-driven characters designed to exhibit human-like behavior in a virtual environment. The key aspects of the approach included:

Development Process: The simulation was built by cloning an existing code repository and then modifying it to introduce personalized characters. These characters were designed to resemble team members, enhancing the relatability and uniqueness of the simulation.

Technological Innovations: The approach was innova-

tive in its use of advanced AI techniques, particularly in how the characters were programmed to store, synthesize, and dynamically retrieve memories, allowing them to plan and adapt their behavior realistically.

Anticipated and Encountered Challenges: The team anticipated challenges in ensuring realistic behavior and interactions among the AI characters.

- Character Customization: Modifying the characters to resemble team members was a complex task. Changes made to the characters were not immediately reflected in the simulation's frontend, indicating synchronization issues between the backend character modeling and the frontend display.

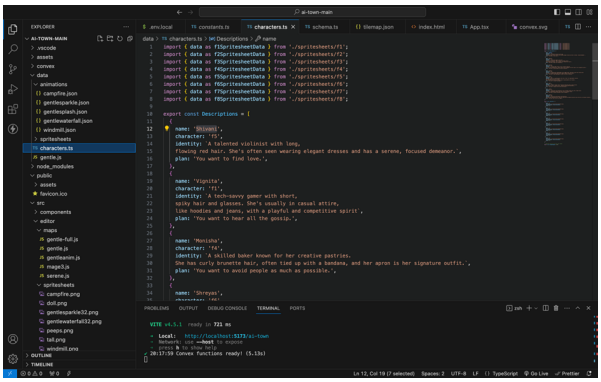

Figure 1. New Characters

- Map Modification: Altering the simulation's map was a cumbersome process. The team needed to create tiled CSV files representing the new map layout and integrate these into the simulation, a task that required significant effort and attention to detail.

- Background Music: We also implemented changes to the background music to enhance the overall ambiance and user experience. This involved selecting and integrating new musical tracks that aligned with the theme and mood of our virtual environment. The choice of music was crucial in setting the right tone for the simulation, contributing significantly to the immersive quality of the user experience.

- Agent Interaction Limitations: Implementing interactions among the agents was not accomplished, indicating a gap in achieving dynamic inter-agent communication and behavior within the simulation.

The inability to implement agent interactions was partly due to the OpenAI API not being freely accessible. This limitation highlights a common challenge in advanced AI-driven projects, where access to key resources, especially those that incur costs, can restrict the scope and capabilities of the development. The reliance on external APIs like OpenAI's for complex agent interactions underscores the need for strategic resource allocation in such projects. These challenges highlight the complexities involved in customizing and enhancing interactive simulations, especially when dealing with intricate aspects like character representation and environmental design. EAGLE GROVE GITHUB

3. Process

3.1. Project Setup

We initiated our project by cloning the 'ai-town' repository from GitHub. This repository was selected for its relevance and potential as a base for our simulation. We then navigated to the project directory, a crucial step for organizing our development workflow. The installation of necessary packages using npm was an essential process, ensuring that all dependencies were correctly installed for the project's infrastructure. We used the command 'npm run dev' to start the development server, which led us to identify and resolve issues related to environment variables. This stage was critical in preparing the project environment, laying the groundwork for the subsequent phases of development and customization.

3.2. Configuring Environment Variables

We detailed the process of setting up essential environment variables for the project. This involved obtaining and integrating keys from Clerk and OpenAI, crucial for the functionality of the simulation. We described how to navigate the Clerk dashboard to create an application, select sign-in providers, and acquire the necessary publishable and secret keys. For OpenAI integration, we outlined the steps to obtain an API key from the OpenAI platform. Additionally, we discussed the optional integration with Replicate for background music generation, requiring a token from the Replicate account. These configurations were essential in enabling the features and security of our simulation.

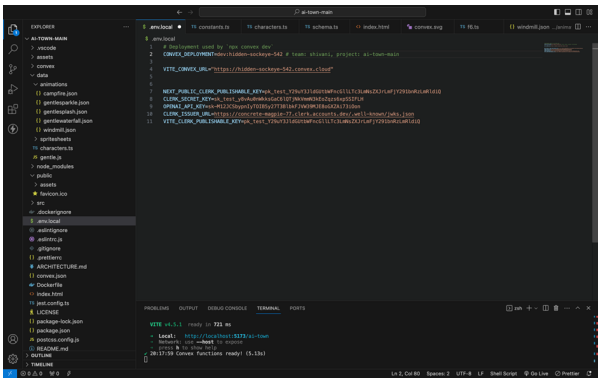

Figure 2. Env variables

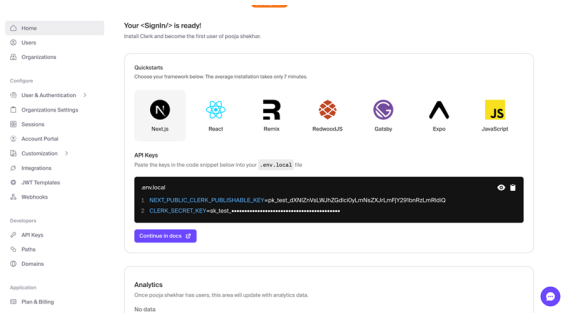

Figure 3. Env variables on Convex

3.3. Deployment and Running the Simulation

We outlined the process of deploying the application and initiating the simulation. This involved executing 'npm run dev' to run both the front and back end of the project, facilitating a simultaneous launch of user interface and server-side operations. We also discussed the flexibility of running the frontend and backend separately in different terminals for better management and debugging. This step was crucial in bringing the simulation to life, allowing us to observe and interact with the virtual environment we had configured. We faced some issue while running the simulation so we ran frontend and backend seperately.

3.4. Creating our own town

We named our town "Eagle Grove", where Eagle comes from the California State LA's Golden eagle. We tried to recreate the simulation with our team members as the characters along with changing the background image and music.

Figure 4. Eagle Grove AI TOWN

4. Developing the Interactive Environment of Eagle Grove

The Eagle Grove virtual environment is crafted using the Phaser game development platform. It integrates custom-designed visual elements like agent avatars and environmental graphics. A server plays a pivotal role in this setup, managing a JSON data structure that tracks each AI agent's location, activities, and interactions within the game world. This server regularly updates based on agents' actions, influencing various elements in the environment, such as changing a machine's status. Agents operate within a defined visual field, reacting to surroundings. Their actions are fed back into the system, creating a dynamic loop. New agents are introduced with a natural language description, forming the basis of their initial behavior.

5. Integrating Natural Language in the Eagle Grove Environment

5.1. Natural Language and Environment Mapping

The Eagle Grove simulation leverages a unique tree data structure to map its environment, crucial for the agents' interaction and decision-making. Agents continuously update their environmental understanding, enabling them to navigate and interact effectively. This mechanism ensures their actions within the virtual world are contextually relevant and informed by their evolving perception of the space around them.

5.2. Deep Learning and Agent Behavior

The project delves into the deep learning aspects that drive the agents' behavior. It addresses the complexities of emulating human actions in digital personas, highlighting the limitations of traditional rule-based systems. The focus is on how the neural network architectures and learning mechanisms are tailored to interpret and respond within the virtual world, ensuring a realistic portrayal of the agents.

5.3. Data Processing and Model Efficiency

Essential to the project is the handling of the data derived from the Eagle Grove environment. The paper could expand on the preprocessing methods used to feed data into the neural networks, ensuring the agents accurately interpret their surroundings. The selection of the loss function and strategies to avoid overfitting are critical in maintaining the generalizability of the agents' behavior, ensuring they don't just memorize patterns but understand the underlying dynamics of the virtual world.

6. Agent Memory and Learning Processes

This focuses on the architecture enabling generative agents to store, synthesize, and dynamically retrieve memories for planning and behavior. The agents record experiences in natural language, which are then used to form higher-level reflections and influence future actions. This approach allows agents to adapt their behavior based on past interactions and learnings, leading to more realistic and coherent actions within the simulation environment. This

memory system plays a crucial role in achieving believable human-like behaviors in the agents.

7. User Interaction and Feedback

The AI agents in the Eagle Grove simulation, influencing the agents' behavior and the environment. Users can communicate with agents using natural language, impacting their decisions and actions. This interactive feature allows for a dynamic and evolving simulation where user input plays a significant role in shaping the agents' learning and adaptation processes. The feedback mechanism demonstrates the responsiveness of the AI agents to user inputs, enhancing the overall user experience in the simulation.

8. Ethical Considerations in AI Development

The ethical implications of developing AI agents with human-like behaviorsThe responsibility of ensuring these agents do not perpetuate biases, the potential consequences of their interactions with users, and the ethical use of data in training and operating these agents. It's important to discuss the balance between creating realistic simulations and respecting ethical boundaries, emphasizing the need for ongoing ethical review and guidelines in AI development, especially as it becomes more advanced and integrated into various aspects of life.

9. Experiments and Results

The success of the project was measured in stages. Initially, replicating the project on a local system was considered the first milestone. Subsequently, the ability to modify the characters in the simulation marked the second milestone. Further changes, such as altering the background map and music, were additional indicators of success. This approach allowed for a step-by-step assessment of the project's progress, ensuring each element was successfully integrated and functional. We failed to achieve agent interactions. The project encountered a significant challenge in the interaction with agents within the AI town simulation. This issue was primarily due to the limitations imposed by the use of OpenAI's API, which might not have been freely accessible or had constraints that hindered full interaction capabilities. This restriction impacted the ability to fully engage with the agents as intended, leading to a shortfall in achieving the desired level of interaction in the simulation environment.

10. Work Division

In this project, the delegation of work was strategic and collaborative. Each team member, Shivani, Vignita, Monisha, Helly, and Nandini, contributed uniquely, leveraging their individual strengths. Helly's creative flair in character design brought the AI characters to life, while Vignita's technical skills ensured the seamless integration of the new map layout. Helly's choice of music enriched the simulation's atmosphere, and Shivani's proficiency in coding provided a strong technical backbone. Monisha's critical eye for testing and feedback was pivotal in refining the simulation. This collaborative effort enabled a balanced and effective approach to the project. A key aspect of our team's approach was the collective reading and analysis of the original research paper. Every member dedicated time to thoroughly understand the concepts and methodologies outlined in the paper. This shared knowledge base was crucial in ensuring a cohesive and informed approach to the project, allowing for effective collaboration and a unified vision in our implementation and modifications.

References

[1] Joon Sung Park, Joseph O'Brien, Carrie Jun Cai, Meredith Ringel Morris, Percy Liang, and Michael S Bernstein. Generative agents: Interactive simulacra of human behavior. In *Proceedings of the 36th Annual ACM Symposium on User Interface Software and Technology*, pages 1–22, 2023. 1

Student Name	Contributed Aspects	Details
Kotian, Shivani	Coding and Debugging	Focused on coding the backend and troubleshooting issues, especially with character synchronization.
Punabaka, Muni Vignitha	Map Design	Oversaw the development of the new map layout, managing the creation of tiled CSV files for integration.
Patel, Nandini Vijaybhai	Character Design	Led the creation and customization of AI characters, ensuring they resembled team members.
Patel, Helly Dilipbhai	Sound Integration	Responsible for selecting and implementing background music to enhance the simulation's ambiance.
Barns, Monisha	Testing and Feedback	Conducted rigorous testing of the simulation, providing critical feedback for improvements.

Table 1. Contributions of team members.