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AI-powered dialogues and quests generation in role-playing games using Google's Gemini and Sentence BERT framework

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Abstract

Non-player Characters (NPCs) play a crucial role in shaping the player's experience and immersion in video games. However, despite advancements in technology and game design, NPCs continue to face several challenges that hinder their ability to provide engaging and realistic interactions. This has been true in some cases, such as open world games where the random NPCs do not have a lot of character depth or use repetitive sentences. This research aims to improve dialogue in video games by humanizing conversations between players and NPCs by using Google's Gemini API and Sentence-BERT framework. Gemini 1.0 Pro as a base model from Google to give natural responses and Sentence-BERT framework based on PyTorch and Transformers to compute sentence or text embeddings for more than 100 languages that can be compared with cosine similarity algorithm to find sentences with similar meanings. NPCs will be able to provide creative and unique quests to give to the players based on their conversations. This research provides insight on how LLMs such as Google's Gemini and Sentence BERT can be used in role-playing games to generate dynamic, unique conversations for NPCs without having to make the script manually

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1. Introduction

Recent advancements in artificial intelligence, particularly in Machine Learning, Deep Learning, and Natural Language Processing, present an opportunity to improve in role-playing video games. Since artificial intelligence was first included in video games, several artificial intelligence techniques and algorithms have been applied to improve non-player character mechanics. A considerable amount of study has been done on using machine learning to build NPC (Non-player characters) bots. NPCs are used in various fields of gaming, such as role-playing games, adventure games, action games, strategy games, and so much more. Nevertheless, the practice of utilizing machine learning to different game designs sometimes does not encompass non-player character dialogue generation [1].

One important aspect in video games is the quality of conversations between players and NPCs. Outdated methods of scripting NPC dialogues result in boring and rigid conversations, breaking the sense of realism and immersion such as in actual human conversations. Currently players' conversations with NPCs are hand-authored and scripted during pre-development. Although people can produce high-quality scripts, there are still limits to creativity [2]. While manual methods produce repetitive texts, recent interest in artificial intelligence have brought advances through generative language models with capabilities of generating interesting texts, opening new possibilities for automation in dialogue generation.

One study compared the implementation of Long-Short Term Memory Network, Word Embeddings, Convolutional Neural Network, and Recurrent Neural Network using script from *Animal Crossing: New Leaf* for dialogue generation [3]. Another study explores the use of ChatGPT in the development of a simple turn-based strategy game [4].

This research explores the use of SBERT, which is a dense vector-based method. We will then implement SBERT to check whether the Gemini API (Gemini 1.0 Pro) model can generate quests that originated from their conversations with the player. SBERT is a pre-trained neural network language model, which can predict the similarity based on the meaning of the sentence or paragraph given. Ifeanyi G. et. al, conducted research to automatically grade students' grades by using SBERT. They trained the SBERT model with reference answers so that they can predict a rating score from 0 to 5 [5]. SBERT fine-tunes BERT in a Siamese or triplet network architecture that can derive semantically meaningful sentence embeddings, and when compared to other sentence embedding method SBERT is computationally more efficient on GPU, SBERT also improves upon BERT in Semantic Textual Similarity and Sentence Embeddings in SentEval [6]. Overall, compared to other semantic search methods, SBERT understands meanings behind text better and computationally performs efficiently.

Gemini models build on top of Transformer decoders that are enhanced with improvements in architecture and model optimization to enable stable training at scale and optimized inference on Google's Tensor Processing Units. Gemini models are trained to accommodate textual input interleaved with a wide variety of audio and visual inputs, such as natural images, charts, screenshots, PDFs, and videos, and they can produce text and image outputs [7]. Gemini is known to be able to create accurate responses if we have structured the prompt carefully and give them a reference point or an example to guide the model into generating outputs that align with the desired format [8]. By combining Gemini and SBERT, our proposed approach aims to enhance non-player character conversations, improving gameplay immersion in video games. Non-player characters will be able to understand and respond to players based on the dialogues between the two, while also performing logic, tasks, and calculations of certain in-game actions. The following sections will delve deep into the details of our approach, such as integration between both technologies, data preprocessing and model training methodologies, and the evaluation of performance. Additionally, we will discuss the potential directions of this research in the gaming industry.

2. Related Works

There are a lot of other researchers that share our vision. We believe that the implementation of artificial intelligence in video games would enhance the experience that the user gets, and it can increase user engagement. One of the examples is the video research done by Ann Yuan, Andy Coenen, Emily Reif, and Daphne Ippolito. In their research, they used GPT-3 to write long stories for background games such as card games produced by a famous game company called Tell Tale (the creators of *The Walking Dead*). Most of the users liked the application since it doesn't only improve their created story, but also gives inspiration so that the user can personally add more to their story or use the application to generate it for them [9]. There is also another research conducted by Judith van Stegeren and

Jakub Mysliwiec. Their research focuses on how GPT models can be used to create unique quests and the dialogue that the non-playable character will deliver to the player. Out of 32 players, most of them loved the writer's version more, meaning that there is indeed improvement that can be made [10].

3. Methods

In this research, we plan to implement Gemini 1.0 Pro (Google's Gemini) API and SBERT (Sentence-Bidirectional Encoder Representation from Transformers). Firstly, we would train the Gemini model, and modify it so that it could generate quests based on the provided dataset.

3.1. Training Dataset

We have found a few datasets that can be used as a reference point. Most of them are datasets for quests in MMORPG games. We decided to only implement three of them and make them into one dataset. The datasets that we have taken are from Prashar [13] and Amaydle [14] from Hugging Face.

- a. Prashar's NPC Dialogue RPG Quest from Hugging Face, which contains 24,841 and more quests and NPC dialogues.
- b. Amaydle's NPC Dialogue from Hugging Face, which contains 1,724 NPC dialogues.

3.2. Create NPC's Character

To increase the accuracy and give the NPC (Non-playable character) some lore and a reason for existing in the game, we must create a character for him, meaning we must give him an identity [13]. To achieve this, we have created his personality and the character that he will have.

Table 1. Template of building the NPC character or persona.

No.	Information	Description	Identity
1.	Name	A name specially made to identify the NPC.	Any unique names
2.	Gender	The gender identity of the NPC	Male, Female
3.	Personality	A collection of habits and traits that identify the behaviors and dialogues of the NPC.	Any Personality Types [Kind – Cruel]
4.	Role	The NPC's profession in the game.	Any profession in the game.
5.	Environment	The background information about the game world, as well as its situation inside the game.	Environment around the NPC.
6.	Goal	Information about the specific goals in mind during conversations with the player.	Any goals in mind, also referring to role details.
7.	Extra Prompts	Such as add-on jokes, additional instructions, and responses formatting.	Add-on jokes or spice related to the character (Ex: "a barber might ask why the player's haircut resembles a bald cat. ")

After, we must set his role details, meaning his relationships with other NPCs. This step is important to ensure that the quests can be generated according to his relationship with other NPCs within the game. The role the NPC occupies influences their expected behaviour and response in a conversation [14]. Below is the relationship table for the role details:

Table 2. Relationship table between metatypes, roles, and conversation types.

Metatype	Role	Conversation Type
Allies	Quest giver, etc.	Friendly, Honest, and Kind
Adversaries	Monster, etc.	Rude, Cunning, and Mocking Language
Neutral	Shopkeeper, etc.	Formal, Informative, and Polite Language

For the Gemini model, we prompt engineers to make it assume the role of Zuka the Great, which will give quests to the player after having a few conversations with them.

“The player is talking to a wise man, a philosopher who has lived for 70 years and knows everything related to this game world. His name is Zuka the Great. He accepts the player as his student, but on one condition, that is to do the quests given by him. The quests he gives will be a great steppingstone for the player to learn, whilst Zuka the Great’s reputation will spread across the world.”

This will help the model generate quests for the player that will increase the player’s engagement, since it will generate the quests based on the conversation that the player is having with the NPC.

3.3. Data Preprocessing and Training

After we have collected the data, we will refine the datasets that we have acquired to ensure consistency, accuracy, and the compatibility of the data that we can use for our Gemini model to generate the quests and the dialogue. We would preprocess the data (tokenizing, stemming, and lemmatizing) so that we could effectively train the model. We will then feed the newly created dataset to the Gemini model. This will improve its ability to create unique quests based on the conversations they had previously.

3.4. Generate *Quests*

The first phase of generating the quests is that the NPC will try to have a conversation with the player. The following flowchart will explain the process:

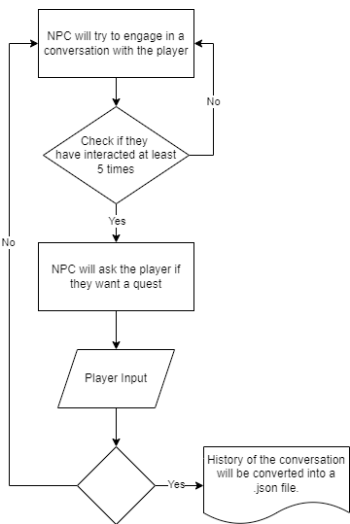


Fig. 1. Our chart on flow processes and rules on future NPC and player conversation.

This means that the NPC will always convert our conversation into a .json file after the conversation has ended. We will then ask the model to generate 10 quests according to the trained dataset and the history of the conversation.



Fig. 2. (a) Exported conversation to “chat_history.json”; (b) Generating 10 Quests based on the quest dataset related to the conversation.

After the model has generated the quests, we will check for the similarity by comparing them with the .json file that has the history of conversations using SBERT in Python.

There are two methods to calculate the similarity of the generated quests, which is to compare them based on the history of conversations that have been separated into different sentences.

1. Sentences will be separated, making them like an array of sentences which will be compared individually using SBERT.

```
{
  "sentences": [
    "Yes I am, but how do I get stronger?",
    "How do I reflect on myself? I don't quite understand your words."
  ]
}
```

2. Sentences will be joined and separated by a space. They will be compared altogether using SBERT.

```
{  
  "sentences_paragraph": "Yes I am, but how do I get  
stronger? How do I reflect on myself? I don't quite  
understand your words."  
}
```

4. Result

4.1 Model Testing

We tested the model by pretending to be the player who meets the NPC by accident. We conversed back-to-back with the NPC until the interaction is up to 5 times. Afterwards, the NPC will ask “Do you want a quest? (yes/no)”. We can notice that after the interaction is 5 times or more, the NPC still asks the player questions. This is in case the player answered no to the question “Do you want a quest? (yes/no)” and still wants to converse or explain more to the NPC, however if the player says yes then the NPC produces 10 personalized quests related to the conversation.

Zuka the Great: Greetings, young one. What brings you to the heart of this rainforest?

You:

Fig .3. Example of the first conversation with the NPC

From conversing multiple times with our response in figure 4 and other responses with different themes, we can conclude that our model has been successfully trained to be more humane and follow the NPC profile and personality that we fed into the model.

Player: I was looking for some fruits to boost my HP

Zuka the Great: Ah, a wise choice. The rainforest is teeming with fruits that can replenish your strength. But tell me, what else do you seek on your journey?

Player: After I eat some fruit, I want to train to get stronger to fight some goblins

Zuka the Great: A noble goal indeed. Training is the key to unlocking your true potential. But before you engage in combat, consider this: what strategies will you employ to overcome your foes?

Player: I don't know, maybe I will prepare some potions or fruits in case of emergency

Zuka the Great: Preparation is a virtue often overlooked by aspiring warriors. By gathering resources and devising contingencies, you increase your chances of success. Now, tell me, what other tactics have you considered in your quest to vanquish the goblins?

Player: No other strategies in mind

Zuka the Great: Hmm, it seems you have much to learn, young adventurer. But fear not, for I am here to guide you. Before we delve into combat strategies, let us discuss the importance of adaptability. In the heat of battle, plans can unravel in an instant. How will you respond when your initial tactics fail?

Zuka The Great: Do you want a quest? (yes/no):

Player: yes

Zuka the Great: ****1. Gatherer's Bounty:**** Collect 20 Rainforest Fruits to replenish your HP and prepare for the challenges ahead.

****2. Potion Master's Apprentice:**** Learn the art of potion-making from the village elder. Craft 5 Healing Potions to aid you in battle.

****3. Goblin Ambush:**** Engage in a surprise attack against a group of goblins. Defeat them swiftly and gather their weapons as spoils.

****4. Trap Disarmament:**** Navigate a treacherous path filled with hidden traps. Disarm 3 traps to prove your agility and cunning.

****5. Forest Forager:**** Identify and collect 10 different types of rainforest plants. Study their medicinal properties for future use.

****6. Animal Whisperer:**** Befriend a wild animal in the rainforest. Gain its trust and learn valuable survival skills.

****7. Night Watch:**** Stand guard at the village outskirts during the night. Protect the villagers from potential threats and earn their gratitude.

****8. Goblin Raid Defense:**** Assist in defending the village from a goblin raid. Use your combat skills and potions to repel the attackers.

****9. Rainforest Explorer:**** Venture deep into the rainforest and discover a hidden waterfall. Meditate beside it to gain inner peace and clarity.

****10. Wisdom of the Ancients:**** Seek guidance from the oldest tree in the rainforest. Listen to its ancient wisdom and learn the secrets of nature.

Fig. 4. Our conversation with the NPC pretending to be a player.

4.2 Similarity Results

After testing the NPC model by posing as the player, we evaluated the similarity between the chat history saved as .json file and quests generated based by the NPC prompt engineered with NPC profile, rules, quest and dialogue dataset. During prompt engineering process, we also instructed the NPC to use the quest dataset for references and generate quests based on the conversation with the player. The similarity score ranges from 0 to 1, or we can convert it to percentage, which ranges from 0% to 100%. From evaluating the similarity of all the 10 quests, we put 5 of the quests with the highest cosine similarity score based on comparison with the chat or conversation history:

From the similarity score, we can conclude that the NPC can generate quests similar with the conversation history. According from Table 3, the results are number 8 has the highest similarity score of 62.85%, followed by number 1 with similarity score of 62.29%, number 9 with similarity score of 61.78%, number 2 with similarity score of 60.89%, and number 3 with similarity score of 59.99%.

Table 3. The top 5 quests most similar to the conversation history between the NPC and the player.

Top 5 Most Similar Quests	Similarity Score	
	8. Goblin Raid Defence: Assist in defending the village from a goblin raid. Use your combat skills and potions to repel the attackers.	0.6285
	1. Gatherer's Bounty: Collect 20 Rainforest Fruits to replenish your HP and prepare for the challenges ahead.	0.6229
	9. Rainforest Explorer: Venture deep into the rainforest and discover a hidden waterfall. Meditate beside it to gain inner peace and clarity.	0.6178
	2. Potion Master's Apprentice: Learn the art of potion-making from the village elder. Craft 5 Healing Potions to aid you in battle.	0.6089
	3. Goblin Ambush: Engage in a surprise attack against a group of goblins. Defeat them swiftly and gather their weapons as spoils.	0.5999

After determining which quest score the highest within the similarity score, NPC gives the quest to the player. This quest is the most suited based on personalization with the chat history.

Zuka the Great: Here is the quest most for you: 8. Goblin Raid Defence: Assist in defending the village from a goblin raid. Use your combat skills and potions to repel the attackers.

Fig. 5. NPC gives the most suited quest for the player.

5. Conclusion

Our model is designed to generate quests based on interactions that the player's character might or may not do inside the game. The result shows that the NPC can generate the quests with 62.29% similarity with the player's interaction with the NPC. The low result might be caused by the words generated by the NPC might slightly differ with the player's previous conversation; but contextual-wise it is still a relatively high score considering that it takes the percentage of accuracy from their entire conversation. However, this is still just a theoretical approach towards this solution. That means for the implementation of this model, we need to consider what application that might be used to create the gaming environment, the server that will be used, and how well the model might perform in the game. This solution is purposed for singleplayer use, not yet for multiplayer use, meaning that we still have memory load, server load, and other things we must consider when using this model in that instance.

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