



The Future of Modern AI Implementations In The Video Game Industry

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Abstract

The horizon ahead for the video game industry is the splicing of AI with the systems involved with developing video games. Large Language Models such as GPT-4 will enhance the gameplay in ways never seen before, the immersivity of gaming will reach hyper-realistic levels in the near future after inevitable innovations from game developers. AI will also transform the gaming industry economically, human positions in game development are receiving major cuts due to AI being able to lower costs and development time because of its ability to perform mundane time-consuming development tasks in a fraction of the time. Both game developers and players should prepare themselves for a shift in gaming paradigms towards dynamically generated, hyper-realistic dialogue, narratives and graphics.

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Chapter 1 - Introduction

1.1 - Project Introduction & Context

The work conducted here aims to demonstrate an effective use of Artificial Intelligence(AI) to elicit accurate, human-like behaviours and reactions from Non-Playable-Characters(NPCs) within the context of a video-game scenario. The AI in question is the Large Language Model and Neural Network systems, openAI's GPT and Google's Gemini, these systems will be used particularly in the context of Role-Playing Games(RPG). The aim of this research is to provide an insight into the potential uses of these modern AI systems and what they're capable of in terms of creating an immersive gaming experience, demonstrated by directly comparing previous paradigms and conventions in RPG games to the AI enhanced game mechanics.

Video games have been evolving alongside technology since their inauguration, with developers adapting the latest advancements in technology in creative and innovative ways to make the overall experience of gaming better for everyone involved by improving production quality, player experience and the integrity of the game itself. One significant technology that's been in a synergetic relationship with game development for decades is AI, with AI being used in development, models, textures, animations and much more (Lewis & Dill, n.d.), so there is much to discuss surrounding this work. A common place AI is seen is in NPCs with developers trying to make them as 'life-like' as possible, this is the focus of this work, trying to use latest available AI to recreate an interaction with an NPC while actively demonstrating how the shift from conventional NPCs to LLM powered NPCs can construct a meaningful, unique and life-like interaction and what this would then mean for other game development sectors.

1.2 - Available Research Tools & Possible Use Cases

The initial objective for this research is to first acquire our AI APIs (Application Programming Interface) that we will use for our program, Google's service: Google Cloud offers access to use the Vertex AI which gives the user the ability to deploy many machine learning strategies and techniques for whatever they may need it for, its commonly used for business and academic purposes. Google also offers use of the Gemini AI, this AI is most similar to chatGPT and allows handling of requests and outputs, this service however is unavailable in the United Kingdom at the time of undertaking this research due to regulation compliance issues (*Introduction to Vertex AI*, n.d.). For this research, OpenAI's GPT API service is accessible through adding funds to an account which will then be used to pay for the tokens you use which provides the opportunity to use GPT in creative ways, in the case of this work the API will be used in a Jupyter Notebook python program to conduct a recreation of a conversational interaction in the game Starfield. (OpenAI, n.d.)

The main aim of developing these scenarios is to draw a comparable and valid demonstration of the potential power of LLM AI interactions and how it's different to the current usual NPC interactions in games. An existing RPG game scenario needs to be selected so an AI recreation of it can be made, that of which comparisons can be drawn between the two. Given the nature of the work being carried out, the selection of a game must have some key features, it should be an RPG with a conversational interaction between the player and an NPC, ideally one where the player decides how they talk with the NPC instead of the player just watching a conversation between their character and another, for example a game like Red Dead Redemption 2 (RDR) has these cinematic-esque interactions, however this is not to say that LLMs and Machine learning(ML) technologies can't be applied to these type of games.

Red Dead Redemption 1&2 instead allows the user to interact with NPCs through greeting or antagonising, which triggers one of many pre-coded lines from the player's character those of which do depend on the general context of where they are on the map, what the NPC & player are doing etc. the game also uses a 'honour system' where the NPC's behave differently around you as if they've already made a judgement on you based on your actions throughout the game, AI ML systems can be shoehorned into this sort of NPC interaction with an AI characterisation and judgement agent powering what the NPC will say/do (*Characters of Red Dead Redemption 2 (2024)*). Potential research and development in AI would add a whole nother dimension to this aspect of RPG games, RDR's honour system is simply a progress bar that your honour stat falls on (lower = bad, higher = good) AI could be implemented to take it away from being a 2D line but instead take it to a more 3D character profile which the players actions can dynamically and accurately alter, NPC's own character and 'opinions' depending on their context profile can have their own interpretation of these AI enhanced character profiles too, offering unique, rich and realistic encounters with different NPCs in the game depending on their own dynamic personality profiles generated by ML and LLM technologies. (Klinkert et al., 2024)

However, two-way dialogue is the focus for this research, Bethesda are the staple game developers for player-controlled NPC interactions with series like Elder Scrolls and Fallout being the most notable titles with this style of gameplay, StarField is a game released in 2023 q4 (Wikipedia Contributors, 2019) which still follows the conventions of bethesda NPC interactions and is new relative to this research, making the game a good case study option as the comparisons being made in this research will not be compared against a drastically different era of game development where modern ML technology didn't exist at all, but instead against a modern triple A title, meaning a more current and relevant discussion of AI innovation can be extracted.

All the above have led to the following aims and objectives for this work.

1.3 - Aims & Objectives

Aims:

- Utilise existing ai models to elicit meaningful and more human like responses from NPCs in a certain gaming environment (RPG games)

- Draw a rich and interesting comparison between the existing dialogue from the game and the AI generated dialogue.
- Analyse the effectiveness of AI improving realistic and immersive dialogue in games.
- Explore how AI can influence other areas of game development to improve the playing experience for players in regards to quality of life aspects and immersion.

Objectives:

- Conduct a thorough evaluation of existing literature surrounding the topic of innovative LLM usage in video games.
- Acquire the APIs for the research
 - Become familiar with the available tools and frameworks that the OpenAI service offers to conduct this research.
- Document requirements and derive criteria to make a better comparison
 - Outline a clear list of requirements which will allow for a direct and meaningful comparison between the original and AI-enhanced interaction.
- Declare and Define a context set for the AI to be used within
 - A description of the context the NPC ‘lives’ in is needed, that of which will be the same for each subject.
 - This is a significant step as it allows for a well defined and measurable comparison of the scenarios being assessed.
- Compare an existing set of interactions in an RPG game (Starfield) and compare it against its AI recreation then draw discussions from this.
 - Present the original interaction and the enriched AI version together

Outcomes:

- Achieve an understanding of the potential of AI and how paradigms in the game industry will be advanced and changed for the better.
- Provide a basis to be built upon of research ideas in the field of AI systems in gaming.
- An improved dialogue experience that showcases the AI’s ability to have seemingly meaningful and unique interactions with the player.

1.4 - Project Constraints

The research being carried out is subject to limitations due to factors such as funding, resources and time. The following are outlining the limitations of the research:

- Computing power
 - The amount of context being fed into the AI will be limited as the systems being used to carry out the research do not meet the necessary standard to be handling massive amounts of data with the AI models.
 - So a limited amount of contextual data will be fed into the GPT model to give it an understanding of the conversation being recreated
- Time

- This research is restricted to having to be done within a nine month period, this will consequently require the research to be concise and able to be completed within this time period. The research carried out in this paper will therefore be structured to provide a basis on the topic of AI in games and a window into the potential of what research could be done in the future to continue innovation.
- Commitments of the Author
 - The author has various commitments during the time this research is happening such as other university work, employment and other personal commitments. As a result of this, it must be noted the work in this paper is completed by a student under these constraints.
- Funding
 - OpenAI's 'pay as you go' service to use the latest model (GPT-4) is respectfully unaffordable for the author to finance considering the author's status as a full-time student and the repeated testing during development of the supporting artefact. Pricing as of the date of research is \$10 / million tokens for input usage and \$40 / million tokens for output usage, 1000 tokens represents ~750 words. The model chosen for this research (GPT-3.5-turbo-0125) currently stands at \$0.50 / million input tokens and \$1.50 / million output tokens. (*Pricing*, n.d.)
- Experience
 - The author lacks experience in certain technologies that in theory would improve the research. This lack of experience is strongly associated with the temporal constraints also, as there would not be enough time to learn new complex skills such as working with a game engine, a skill that takes a substantial amount of time to become familiar with.
 - The author also does not have a high-tier of understanding on how to create the optimal prompt to feed the AI. With the emergence of LLMs publicly, 'prompt engineering' an optimal AI request has become a desirable skill to acquire.

1.5 - Risks

The undertaking of this research will naturally come with risks associated with it, an overview of potential risks are listed below:

- **Computer integrity**
 - It is possible that the author's computer being used to carry out this work's documentation could get damaged or compromised resulting in unnecessary delays and difficulties in completing the work in the time frame given.
- **Data Risks**
 - Some biases or low quality data in the datasets used to train the AIs may result in undesirable dialogue outputs, such as the AI generating dialogue based on conventions of the game genre instead of contextually correct dialogue.
- **Management of the project**
 - The scope of the research could expand as the research commences resulting in difficulties for completion of the work within the specified time frame.

- Communication with supervising staff must be consistent and progressive, a lack of communication due to unforeseen circumstances will negatively affect the quality of the work and lead to misalignments of expectations.
- **Ethical Risks**
 - Societal biases being reinforced by the AI during its dialogue generation, as the AIs in use are trained using the internet as its dataset, biases that exist on the internet such as racism could lead to some ethically concerning dialogue production. The AIs used in this project have had years of development to avoid these generations compared to older models such as GPT-2 (CellStrat, 2023).

1.6 - Deliverables

The target of this work is to provide dialogue interactions that have been enhanced using ML AI technology; these interactions will be a direct recreation of existing dialogue in the game ‘Starfield’. The APIs will be used in a Jupyter python script that feeds the AI the lines of the conversations and generates a response based on the original responses, as to keep the conversations on track and not ‘open-ended’ for the AIs creativity.

From this, an in-depth discussion will be extracted about what these improvements in player-AI interactions means for the players, improvements in realism, and AI’s modularity across other sectors of game development.

The deliverables will ultimately be code outputs and an analysis of these and the original conversations. Analysis will be heavily focused on the ‘doors’ AI will open up for shifting the paradigms of video game development.

1.7 - Ethical Considerations

- This project does not require human volunteers for research gathering therefore no ethical / social issues arise for treatment of participants in the research as the work is solely conducted by the author.
- All tools and data collected for this project is paid for and is GDPR compliant.
- There is a small risk that the output of the AI could be biased or potentially racist due to overall biases in the training set for GPT which is the internet. However the model in use for this work is relatively clear from these issues in respect to the requests it will be handling for this research project.

1.8 - Project Management

To handle this project the author adopted an agile methodology to complete each section of the research, mentally dividing segments of the projects into smaller chunks to be completed on slightly varying deadlines to accommodate the commitments of the author being in full-time level 6 education. A Gantt chart was constructed at the initiation of this project which outlines the rough deadlines each segment of the work should be completed by, see Gantt chart below:

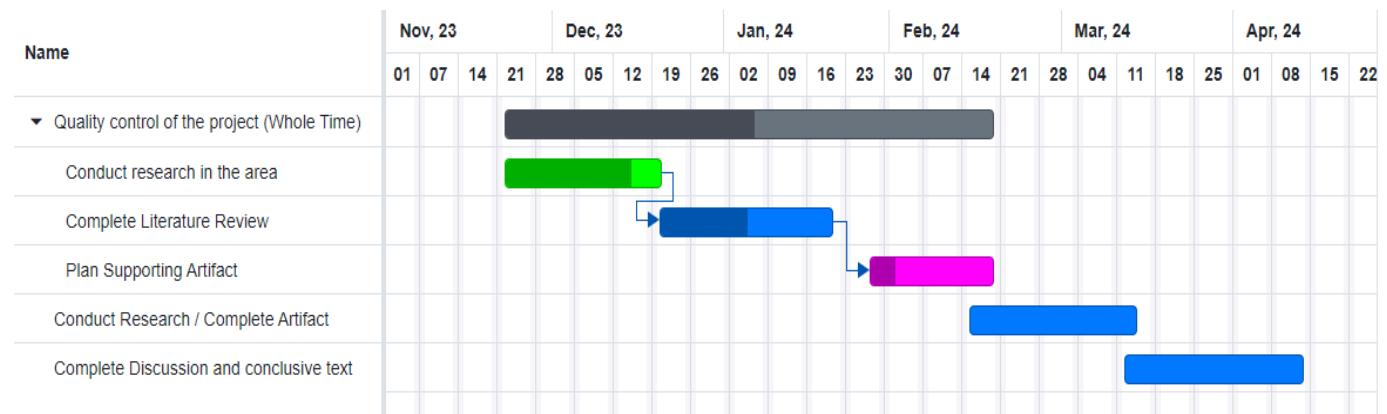


Figure. 1 – Gantt chart

Kanban was the ideal agile methodology best suited for the work-style of the author. Kanban is a strategy which involves organising your workload into tasks that are: completed, currently being done, need to be completed next, and future tasks to be completed afterwards. This is an effective strategy for managing a project where inconsistencies and downtimes are expected, deadlines can be manipulated and unforeseen circumstances can be mitigated easily.

The different segments of this project will inform other chapters of the research, beginning with the Project Initiation Document (PID) which informed the general areas of research covered in the literature review and provided a basis for designing the methodology and structure of the research. The literature review then provides topics of discussion for the discussion chapter alongside the analysis of results from the supporting artefact. A conclusion is then extracted from the project as a whole, however the discussion chapter influenced the conclusion more than other chapters. Below is a simple diagram of the mental structure behind this work.

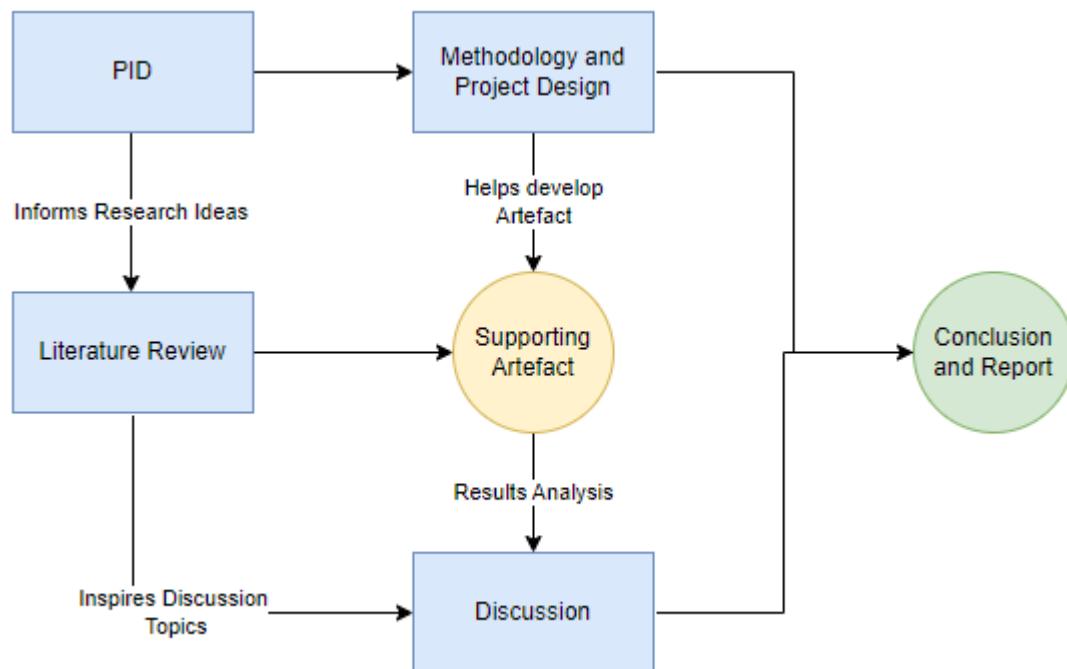


Figure. 2 – Mental Structuring of the Project

1.9 - Key Research Questions

Relevant key areas of research must be outlined to conduct an insightful analysis of surrounding literature, the research questions are designed to be thought provoking while also providing a thorough but informative overview of the current and future understanding of what AI is capable of and any issues that are associated with this.

1. What is the current forefront of research in AI implementation in the video game industry?
 - a. What avenues could AI potentially go down?
 - b. What are the implications of current research on other aspects of video game development / enjoyment?
2. What ‘types’ of AI are available today?
3. What are we to expect for the future?
 - a. Are these expectations ‘sci-fi’ or grounded and realistic?
4. Is the indefinite progression of AI ethically sound?
 - a. What potential problems will arise from AI getting closer and closer to realism?
5. How do current and future AI applications benefit the player-base and developers?
6. Can AI improve immersive gameplay?

Chapter 2 - Literature review

2.1 - Research Strategy

To begin this research, one must first acquire an understanding of some of the systems that make up AI, systems such as Natural Language Processing, Neural Networks and Machine Learning. The author has studied computer science since 2017 and regularly enjoys / studies video games. Knowledge of the basic systems that allow AI to operate was gained through separate university education that took place concurrent to this research.

Reviewing literature necessitated extensive reading into academic papers and documentation about AI. To carry out this research the author searched for relevant articles on academic databases such as Google Scholar, IEEE xplore and arXiv as well as reviewing information from trustworthy websites and books. The strategy practised to discover relevant literature was following the ‘chainlinks’ of references, so the author would read a paper to elicit interesting discussion points and then investigate the references in that paper to read more, the same would then be done for that paper.

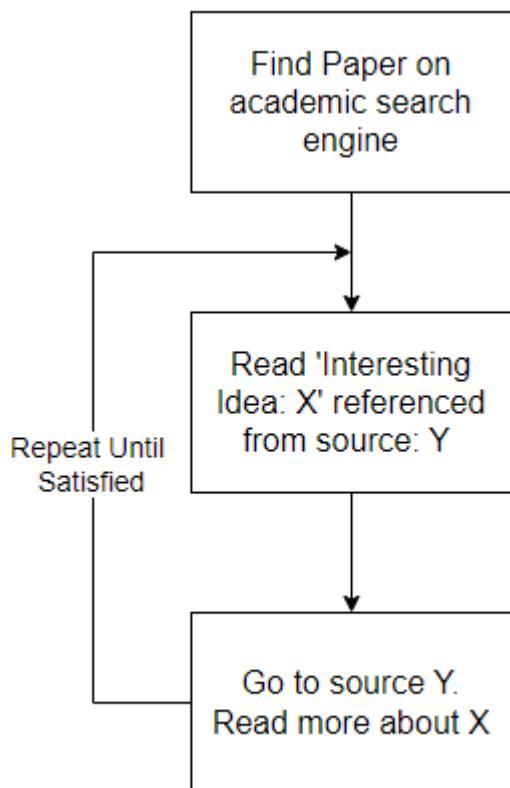


Figure. 3 – ‘Chainlink’ Research Strategy

2.2 - Introduction

This chapter will examine past and current research being done in regards to the splicing of AI and video game development, research will be done looking into how the recent breakthroughs of AI Technologies such as Natural Language Processing (NLP) and deep learning neural network models like GPT and generative AI can take the world of playing and developing video games to a completely new level in terms of realism, innovation, immersion and overall enjoyment.

AI, as most will recognise today, are deep neural networks being used for natural language processing to recognise patterns and rules in order to synthesise behaviour and reactions suitable to whatever request the user is feeding into said AI. AI currently has a wide plethora of applications in different industries, for example it has seen use in retail, manufacturing, healthcare and life sciences,(CSU Global, 2021) however this work will focus on one very exciting industry, the video game industry, that has been ambitiously using AI for a vast array of applications for decades, such as Player Experience Modelling (PEM), believable NPC agents and procedural content generation, as shown in fig.1&2 (Xia et al., 2020). To understand the huge potential of AI in video games, one must first need to understand what AI is and what types of AI are available today.

The GPT framework is a particularly fascinating technology and one that will be studied considerably in this work. GPT stands for Generative Pre-trained Transformers and is a collection of neural networks that use the transformer architecture,(*What Is GPT AI? - Generative Pre-Trained Transformers Explained - AWS*, n.d.) it has made big breakthroughs in Natural Language Processing with its impressive ability to understand and generate human language to a point where it's tricky to distinguish between a real person's behaviour and the AI's behaviour in some cases.(Mei et al., 2023) Using openAI's GPT (OpenAI, 2024) will show you it is capable of answering or generating most requests from the user, now it's not too hard to imagine the possibilities in the future with this technology especially in regards to the many technologies involved with developing video games. This technology has the ability to 'remember' context of conversations leading it to generate more coherent speech when the user is interacting with it and referencing things covered in previous messages,(*Memory and New Controls for ChatGPT*, n.d.) with this in mind one could imagine how much more immersive a Role-Playing-Game could be if every Non-playable Character (NPC) could be loaded with a contextual background of their character and the player could interact with every character they see and not receive a basic filler response from a small handful of pre-recorded responses, instead there would be dynamic and more interesting responses, pair this AI up with other systems such as AI Voice generation and you have a massively improved gaming experience, it is ideas like this that are on the forefront of latest research and innovation.

2.3 - Realistic Voice Generation Using AI

Relatively, this technology is in its early stages regarding its use for the development of games, and a few developers and researchers are implementing GPT and exploring its limitations, for example some APIs have been developed for integrating GPT into the unreal engine, allowing use of chatGPT and DALL-E image creator in the game engine.(Iucoiso, 2023) A common idea is GPT being used in chatbots/NPCs in rpg games, many people have shared their small projects online showcasing how new GPT can make speech in RPG games way more interesting to the user, for example the 'Mantella' mod for the game Skyrim ties AI into the NPCs (*Best AI Mods for Skyrim: Skyrim*

ChatGPT Mod and More!, n.d.). Future games utilising AI chatbots could allow NPCs to dynamically understand the context of given situations, make suggestions to the player or potentially give users items if the user navigates the conversation well enough. There are still many issues with this experimental use of AI, is everything the chatbots say relevant in the universe of the game? Are the topics GPT will reference things the player could then actually go pursue further, or are they just made up on the spot by the AI? For example if GPT replies “ Ah yes, the Western Kings Castle! It’s said there is a mighty treasure within.” GPT will generate this response based on general Fantasy game conventions but the object of the response will not necessarily be in the game at all, this is an issue with the scope of the AI and the challenge is to restrict it so it is still vast and immersive but the replies are true to the logical scope of the game. This topic of concern is discussed further on this forum: (Organic Thought1241, 2023).

Artificial Voice generation is an exciting tool for video-game developers, this is a technology that can generate voice lines from text after being trained with recordings of the desired voice being generated, it does this by utilising Deep Neural Networks for the learning and analysis of pace, tone and pitch for the synthesis of a voice (Gomedé, 2024). Voice overs have been used in games for decades and are a very important part of an immersive video game, it gives characters a human sound and allows for the player to connect to the characters much better than reading subtitles for example. To achieve this immersiveness in games, developers have the key task of realistically syncing up the gameplay with the voicelines to appear seamless, as if the characters are really talking themselves, this can be hard to nail when using pre-recorded voice lines by voice actors as the developers must overlay the audio very meticulously and the voice actor must be able to fully engage with the characters they are voicing. This costs money, a good developer and voice actor also cost a lot of money for their time, especially if your game has many scenes that may need multiple takes to perfect. AI can aid not only in voice synthesis but also in dynamically adjusting character emotions to change depending on context of what the character is feeling and saying, resulting in realistic and believable animation of NPCs body language and synchronisation of lips and speech. (Westera et al., 2019).

This is where AI comes in, recently in the past couple of years voice generation has become nearly indistinguishable from normal recordings, this technology has been used in the first-person shooter game, The Finals. This video game had a fantastic launch peaking with 242,619 players in the first few days (*SteamDB*, n.d.), the game has game-show announcers whose voice lines are completely AI-Generated using text-to-speech software yet they sound incredibly authentic. The creators of the game said this in a podcast interview: “At the 6.30-minute mark [in the episode](#), they are asked the question, “Who did the voiceovers? As they sound really authentic.” They responded, “So here’s the kicker: **what did the voiceovers? So the thing is, we used AI with a few exceptions, so all the contestant voices, both of our commentators are AI text to speech.**” (Hellyar, 2023).

AI voice overs allow for great innovation in making improvements in immersive gaming experiences, not only does it allow developers to cut huge costs on employing big names for recording sessions but it also means the aforementioned seamless synchronisation of voice and what's on the screen is much more accurate (Porokh, 2023). Speech in-game can be much more flexible depending on what's happening, responses can be dynamically generated depending on the situation a character is in, the voice of a character can vary appropriately say if the character has food in their mouth, is exhausted or in panic, the same voice lines can be delivered but with appropriate vocal variation. Instead of a pre-recorded voiceline just being emitted from a character irrespective of environmental context. Another view of this subject may take us down the path of whether it is ethical to cut out voice-actors as a whole and whether the community playing these games actually wants all this AI-driven

technology in their video games. Will games get so realistic that the player wouldn't just go outside? (Organic Thought1241, 2023) Further insight on the impact on professional voice actors is granted by the research (Marr, 2021), Marr discusses the topic with co-founder of LOVO Tom Lee where he states that voice actors should see this not as a threat, but as an opportunity for improved working hours. Recordings used to train AI models will grant actors passive income in the form of revenue shares, your voice should work in your sleep he states. Suggestions like this highlight the great benefits AI can bring to people and their quality of life in areas where there seems to be an abundance of doubt and worry. The technology is simply fresh out of the gates and necessitates a lot of adapting and research to ensure it's integration into society is safely cradled down to minimise economic hurt and displacements.

2.4 - Intricate NPC Personalities using LLM

Humans are emotional creatures, and this translates into the media we consume. When people get into a film, depending on how good the actors/actresses are, they may cry, laugh, get annoyed or be creeped out etc etc. The same applies to playing a game, depending on how well it's constructed, it will elicit emotional responses from the player, this means the game has got the player hooked and immersed in the environment of the game (Wirth & Schramm, 2005). What AI can help with is making characters unique with a full personality the player can interact with and connect to, video game NPCs have always felt a little robotic during active gameplay, their interactions tend to only serve to progress the story and this is one of many factors that is holding back a true connection to the universes developers are trying to make (Nnoli, 2023).

GPT can be used to develop a personality for AI characters to help strengthen the connection between the player and the artwork of an RPG and can make situations such as an in-game death seem all the more devastating if the character dying doesn't just feel like pixels on a screen but a character you have personally bonded to through the role-playing experience. The capabilities of ChatGPT-4 allows for this innovation to blossom, creating a compelling gaming experience requires intelligent, real-time feedback to player-NPC social interactions and GPT-4 can craft authentic behaviour such as expressions and decision-making (Harbottle, 2023). In this article he explores the possibilities of the newest model GPT-4 and what it offers for immersive gaming experiences by enhancing conversations and what GPT can generate on its own for a video game, he demonstrates the uses of GPT in simple python code, the possibilities are endless given time for people to innovate with this incredible technology.

GPT-generated personalities is where immersion in gaming will take a huge step forward. A 2024 paper (Klinkert et al., 2024) research is done into the field of current and potential uses of Large Language Models (LLM) for generating realistic content representing given personalities, particularly in the case of video game NPCs. **"In one scenario, context clues could be provided, prompting the LLM to retell a story. The given personality would guide the model to focus on aspects relevant to that personality, influencing the choice of semantics to reflect the character's disposition."** This revolution of how we interact with NPCs will eliminate the need for a developer to 'babysit' the story and gameplay to how they intended, gameplay can still conclude how the developers intended but the player may take a completely different and unique approach to get there. This paper describes

the need for ‘Context Clues’ to drive the Personality to understand the context of what is going on and how the personality should perceive and react to the given game scenario. In the conclusion of this paper it is stated: “ **LLM’s proper use of personality information by repurposing the IPIP questionnaire, a human measuring technique to determine personality, has revealed promising potential for creating more engaging and realistic NPCs**” and also: “**The continual improvement of LLMs, such as the current dominating gpt-4-0613 model, will only further improve the output of proper behaviors**”, this supports the ambitious view on the topic; AI will only get better and better for making games immersive.

2.5 - Concerns For Morality

In this particular field of research, questions arise involving the ethical/moral considerations regarding the psychological effects on the players of these games. If this technology is striving to create immersive, realistic and emotional experiences then there may be a time where we reach a point where emotional trauma can be caused by experiences in a fake world, why wouldn't a ‘fake’ gaming experience with realistic and dynamic characters, voices, environments and graphics be a heavy burden for the standard human conscience to endure?

Some video games contain scenes where the sole purpose is to shock and invoke an emotional response from the user, typically seen in the War genre of video games. The themes of these games are usually distressing as is the nature of war, a few examples of shock-scenes are Call Of Duty Modern Warfare 3’s van-bombing scene showing a mother and child falling victim to a terror attack (*Davis Family Vacation*, n.d.), Call Of Duty Modern Warfare 2’s ‘No Russian’ mission which involves participating in a shooting terror attack. These controversial violent scenes are particularly common in the Call Of Duty franchise as they are considered an artistic, gritty reflection of the horrors of the real world of war and developers feel they shouldn't shy away from artistic representation. The ‘No Russian’ mission was famously banned/removed in Russian releases of the game as it was too gruesome and the victims in the mission are all russian civilians, in all other releases the player has the option to completely skip the mission and are warned about traumatic imagery. (*No Russian*, n.d.) Call of Duty modern warfare 2 was also the biggest selling videogame of 2009 so it is not like this controversial imagery is only reaching a niche audience of gamers. (Campbell, 2013)

The typical stance regarding this is that it's problematic as video games are interactive (Tavinor, 2009, pp. 163–164), this is where the concern regarding AI comes in, as AI is bettering and slowly blurring the line between what's real and what is not, from this spawns a worry about distressing artwork in games being reproduced with hyper-realistic AI technology to aid the realism of the emotional demonstrations in the scenes, the realism of the environment such as explosions and weapon-fire, the accuracy of graphics, all of which generative AI can enhance the quality of (Harbottle, 2023). With such enhanced realism this begs the question of how careful game developers must be in the future to make sure the games are safe and enjoyable for all stakeholders, particularly the playerbases, by taking into account that the more real an interactive video game gets, the greater the risk of people taking offence or losing themselves in the game and encountering depictions that may be too traumatic for the public to view without risking psychological damage.

2.6 - Future of Generative AI generating game content independently

One of the more revolutionary uses of AI in the gaming industry is the ability to independently generate appropriate content using AI and Large Language Models, content such as Quests and 3D spaces can be generated using LLMs. 2023 work, Sun et al. (2023), documents a basic framework for modelling 3D scenes using a procedural generation approach which they have coined “3D-GPT”, this framework integrates 3 agents: task dispatch agent, a conceptualisation agent and finally an agent for modelling. These agents come together to firstly enhance scene descriptions, moulding them into more detailed forms while also dynamically adapting the text prompt, for the procedural generation part of the software, it will infer parameter values from these enhanced text descriptions to generate a reliable desired model. This work grants a lot of promise for the future of AI systems for game development, systems like this 3D-GPT can work in tandem with other areas where GPT can be integrated to dynamically produce prompts for the task dispatch agent thus potentially allowing systems to self-generate entire 3D spaces based off one player-game interaction for example. “3D content creation serves as a catalyst for transformative progress, redefining multimedia experiences in domains like gaming, virtual reality, and cinema with intricately crafted models.” (Sun et al., 2023, pp. 1–2).

Using AI for other content generation such as improving NPC behaviours has taken a turn in recent years from focusing on low-level controls, such as navigation, towards high-level NPC behavioural patterns that aim to affect the validity of knowledgeable, believable, intelligent and human-esque behaviours of NPCs those of which include but are not limited to emotion modelling and adherence to socio-cultural norms/conventions (Yannakakis, 2012). The goal of this innovative switch of focus is to achieve flexible NPCs which do not rely on completely scripted behaviours but instead portray an active and dynamic reaction to different stimuli to appear as human-like as possible (Westera et al., 2019, pp. 357).

Now following this train of thought, the ideas of where else this sort of innovation can be applied are in abundance when considering the scope of all the technologies involved with developing video games that would benefit from improved realism and human-likeness. The very core of game design is an inseparable tandem of the engineers and AI to progress the creation of compelling experiences, expression of most games is communicated through medium of AI, almost all aspects of video game development ties to AI; models, textures, animation and most other art assets including music can be dynamically modified in order to evoke reactions from the player (Lewis & Dill, 2017, pp. 6–7). With AI being described as “The Nexus of Game Development”, the optimistic approach to advancements in AI is only further supported. It’s easy to draw the connection between the massive technological improvements of NLP, LLM and neural networks advancing all aspects of game development.

The frontier of this field mainly focuses on a certain few applications of AI, the behaviour of NPCs and their dialogue, PEM, procedural content/level generation(PCG) and general game AI(GGAI) (Xia et al., 2020) this section will be focusing on NPC’s life-like behaviour in particular. This is a rich area of development as systems that focus on bringing characters to life are being rolled out in 2023/24, these systems boast the ability to move NPC interactions away from being ‘transactional, scripted and short-lived’ by allowing AI to create personalities that evolve over time and give dynamic responses unique to each playing experience (Nnoli, 2023). The Nvidia ACE(Avatar Cloud Engine) is technology which allows for customisable NPC experiences by making use of LLMs for creating personalities within whatever contextual backgrounds the developer pleases, the system then makes

use of a couple other AI systems, nvidia Riva and nvidia Omniverse Audio2Face, in order to really bring the character to life. These further AI systems specialise in speech synthesis and recognition and instant facial expression animation enumerated from an audio source, this AI in particular is available for people to use in the Unreal Engine 5 so it is not just some inaccessible speculative tech. Finally after this character alignment, Nvidia's 'NeMo Guardrails' are applied which restricts the character to programmable rules defined by the developer, allowing for accurate, on-topic NPCs. This is the very forefront of real, revolutionary AI applications for game developers and is a current showcase for the direction gaming is going, the software is already being utilised by developers such as GSC Game World and Fallen Leaf (Nnoli, 2023).

NPC interactions will be more lifelike than ever before using nvidia's innovative softwares, Dhar (2015) explores the belief that deep learning's future lies in AI exhibiting common sense and the ability to make sensible decisions and connections like humans do so trivially, such as 'getting shot at → take cover somewhere, AI like this should result in a better playing experience (Skinner & Walmsley, 2019). The development of NPCs into near human-like entities should indefinitely improve the playing experience of a game, as the more they can behave with human decision making and behaviour, the more contextually coherent generations will come from the AI resulting in a 'lose yourself in the world' gaming experience.

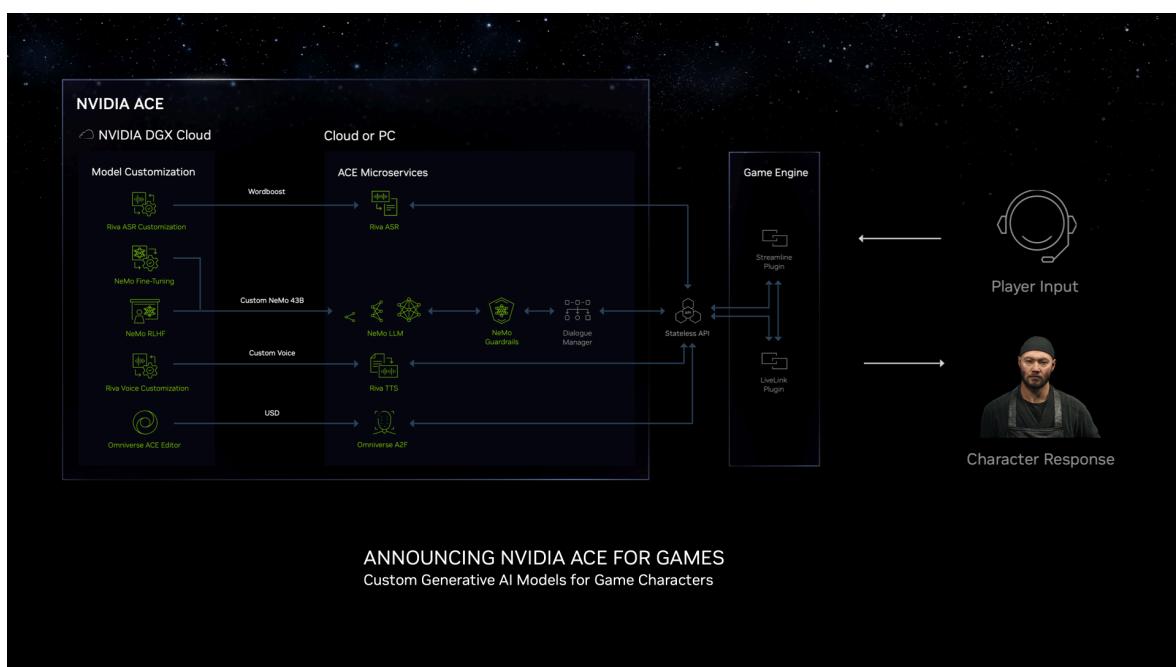


Figure. 4 – Multiple AI systems powering realism in Nvidia ACE (Nnoli, 2023):

This diagram visualises how the different integrated AI systems coordinate themselves to produce realistic effects, this really demonstrates the potential of AI in the future, the entire network appears open to addition of further more advanced technologies to aid the final output of an authentic Character Response.

So how limitless are the capabilities of NNs and deep learning AI? Skinner & Walmsley (2019) draw a conclusion that capabilities of machine learning "as far as we can predict, are limitless" while reviewing literature where Chollet (2017) made the prediction that we will see Neural Networks being engineered by other systems that utilise libraries of subroutines those of which are expanded by other

AIs with endless datasets. The idea is that these AI models will achieve the ability to assess a new task and instantly assemble a new model that can perform said task with very little training data, similar to how humans learn a new video game with little to no experience of that particular game. This is an outlook which we are now starting to see come into reality with such generative technologies like nvidia's ACE. So AI determining the actions of other AI, also AI dynamically 'reproducing' specialised AIs for specific problems could be where computing is headed.

2.7 - Summary of Literature

The current climate of research in LLMs and NNs is rich and saturated with many avenues being explored and a promising future ahead. AI technology is finding its place in many areas of video game development from dynamic content generation, such as 3D spaces and dialogue, to realistic improvements to games themselves. The apparent conclusion from the vast amount of current research is that AI is incredibly modular in regards to ways it can be implemented across the many systems that comprise the process of developing a video game, from the limited literature explored above, it seems AI has a promising horizon ahead as innovation can be found across almost all sectors of the industry. It is the opinion of the author that there are plenty of unexpected, yet to be known benefits that both developers and players can reap from generative AI rooting itself in the foundations of game development, the many advancements being discovered in current research since the 'inauguration' of LLMs and NLP like chatGPT only releasing on 30th November 2022, just over a year before the time of this paper being written, (Wikipedia, 2022) such as 3D-GPT are a strong indication that we have many unforeseen, revolutionary applications of generative AI ahead.

Chapter 3 - Research Design - Supporting Artefact

3.1 - Introduction

This chapter is dedicated to exploring the pivotal role of AI in enhancing the development of video games, demonstrating its modularity and adaptability across various systems in the form of a python program. As the gaming industry continually seeks innovative methods to captivate and engage players, AI stands out as a transformative tool. This research delves into how AI not only streamlines game development processes; such as character behaviour simulation, procedural content generation, and real-time decision making, but also significantly enriches the player's immersive experience. By integrating sophisticated AI techniques, developers can create more dynamic and responsive gaming environments that adapt to and anticipate player interactions, thereby elevating the overall gameplay experience. The following section will unpack the requirements, processes and considerations extrapolated from the subject of this research in order to produce a meaningful supporting artefact.

3.2 - Strategy

The design of this research is that of an experiment. The experimental approach includes imposing control over all variables except one or a few variables that of which the behaviour will be analysed as results, the primary aim being to establish a cause-effect relationship among said variables (Winston-Salem State University, 2022). This methodology is appropriate for the work we are carrying out here as it allows variable manipulation which, on a broader scale, will represent other systems in video game development and their ability to seamlessly operate in tandem with AI models. This methodology also supports the component-based design of the program by separating key components into variables that are easily interchangeable.

3.3 - Research Design

3.3.1 - Requirements

The design of the research begins with the selection of the scenarios that are going to be recreated. RPG video games share a common trope, a HUB area where the player can usually purchase properties, acquire quests, purchase items and travel to other places (Schuller, 2017). The author purchased the source game (Starfield) using Microsoft's Game-Pass subscription service costing £1.00 and then played the game up until the player was at the 'HUB' location called 'New Atlantis' where interactions with generic NPCs can be found.

The interactions chosen from this area were informed by the literature research chapter and was the decision of the author, however some requirements need to be elicited so appropriate NPCs are chosen with respect to the context and purpose of the research. Some of the requirements are as follows:

- The Interactions must be otherwise mundane interactions that the player would usually forget about and serve little purpose to the main story arcs in the game.
- The NPC interactions should also be mundane and tedious for the developers, in regards to when the voice lines are being recorded, the writers writing the dialogue and the effort involved with minimally fleshing them out. This is because we are focusing on the capabilities of AI aiding game development and fulfilling otherwise neglected parts of the game with interesting generated content.
- Must have a substantial amount of back and forth conversation.

These requirements are designed as such so that a meaningful and provoking discussion can be drawn from the research, a discussion highlighting how some of the most neglected nooks and crannies of a video game can be enlightened with dynamic AI generation and interpretation.

To outline the requirements of the supporting artefact, a practice known as the MoSCoW template will be used. This is a suitable method for eliciting requirements because it functions by categorising the

functional features of the script into ‘Must-haves’, ‘Should-haves’, ‘Could-haves’ and ‘Would-haves’ resulting in a very clear, priority-sorted template (Brush, 2020). The python script will have some key functionality requirements for an effective portrayal of AI’s potential, the requirements are as follows:

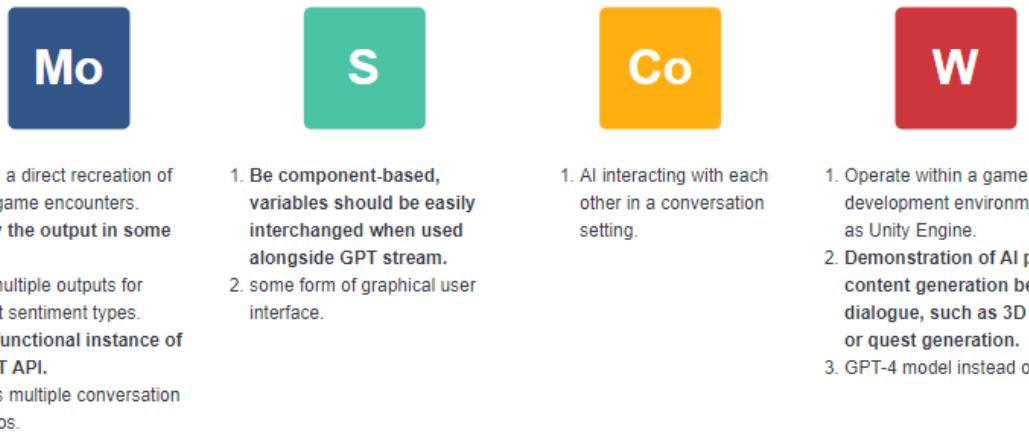


Figure. 5 – MoSCoW Requirements

3.3.2 - Python Script Plan

The script will exercise the manipulation of variables of data type String and will consist of multiple core components:

- An array of lists containing the transcripts of the NPC’s in-game responses.
 - These transcripts will be provided to the AI as an answer to base its response on, otherwise the response will be too open-ended and creative script-writing will be obsolete.
 - Used as ‘Guide Rails’ for the GPT instance.
- An array of lists containing the scripts of dialogue options chosen by the player, that are paired appropriately with the corresponding NPC responses.
 - These will be used in the same fashion as within the game.
 - AI will be responding to these prompts.
- A Context variable, this variable will be used to tell the AI the general characteristics of the scenario they are in. Aspects such as:
 - A description of the world they are in.
 - A description of the person they are talking to, such as their gender, clothes and build, the first impressions data.
 - Lastly a description of who the AI is representing, so some information about the NPC the voice lines were gathered from.
- An array of four different sentiment types that the conversation will be undertaken in, comparisons will be drawn about GPT’s ability to create realistic, adaptive and emotive responses. The four sentiment types are:

- Cheerful
- Tense
- Neutral
- Sad
- A Graphical User Interface (GUI) to show the dialogue.
 - Provide the prompts and responses in a formatted display.
- A running instance of GPT-3.5-turbo-0125
 - Streaming the API service to handle the prompts / requests.
 - Requires 3 constant variables to grant access to the API, to assure the user is authorised to access the API.
 - OrganisationID
 - ProjectID
 - API_Key

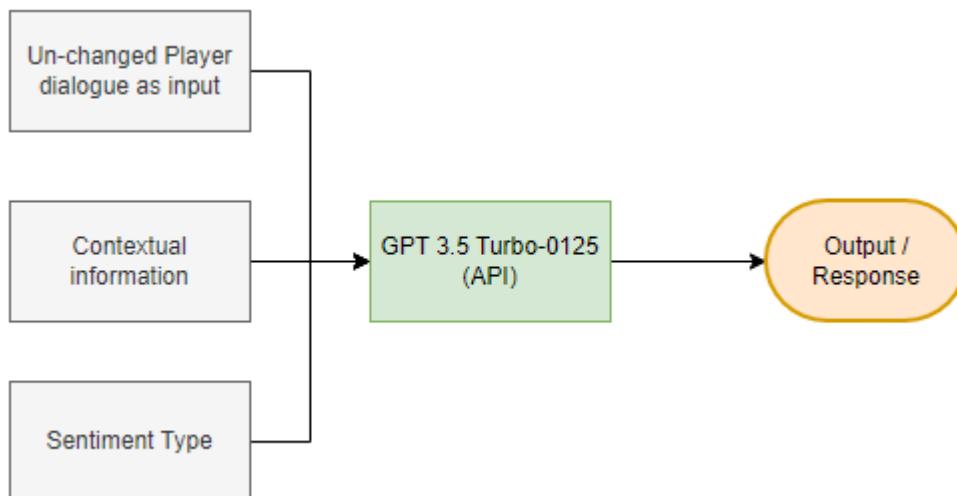


Figure. 6 – Conceptual Model

3.3.3 - Defining The Context Set

An imperative feature of this python script is defining the context for the AI to interpret. This is an important step because this is what will be analysed, GPT-3.5's ability to understand the environment it is supposed to be in and how well it can play the role of the NPC. Within video games, especially RPG games, there are usually perks and features that the player possesses that affect the players ability to succeed in certain situations, for example a player might have the 'Intimidator' perk which gives them an aggressive demeanour to pass aggressive dialogue options (Zagal & Altizer, 2014). This is very interesting as this system can be boiled down to just a boolean variable which can be fed into the AI's understanding of a given situation, thereby highlighting further the modularity of LLMs and AI in video games, pre-existing variables within games can be used to aid the AI integration instead of being an obstacle for developers trying to shoehorn AI into their development. This idea

suggests that existing employees may not need to undertake much training and acclimation when using AI in newer projects.

Starfield is not exempt from this RPG trope, initiating the game with a brief ‘Background’ and ‘Traits’ selection page, these selections are what the AI will interpret as the context of whom they’re talking to. The ‘Traits’ will be excluded from the code as these are personal characteristics that the NPC subjects would not know about the player’s character upon first encountering them, this however does not mean elements of the player like their ‘Traits’ could not be discovered by NPCs given further interaction throughout the playthrough of the game.

Background features selected by the author:

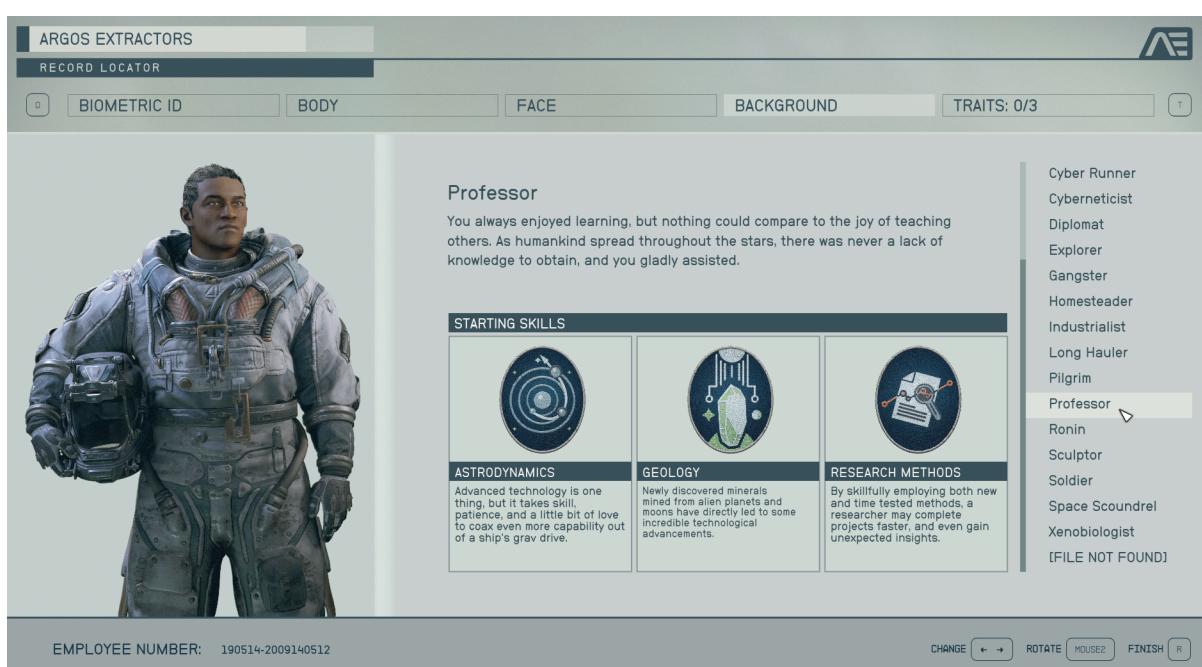


Figure. 7 – Character Background

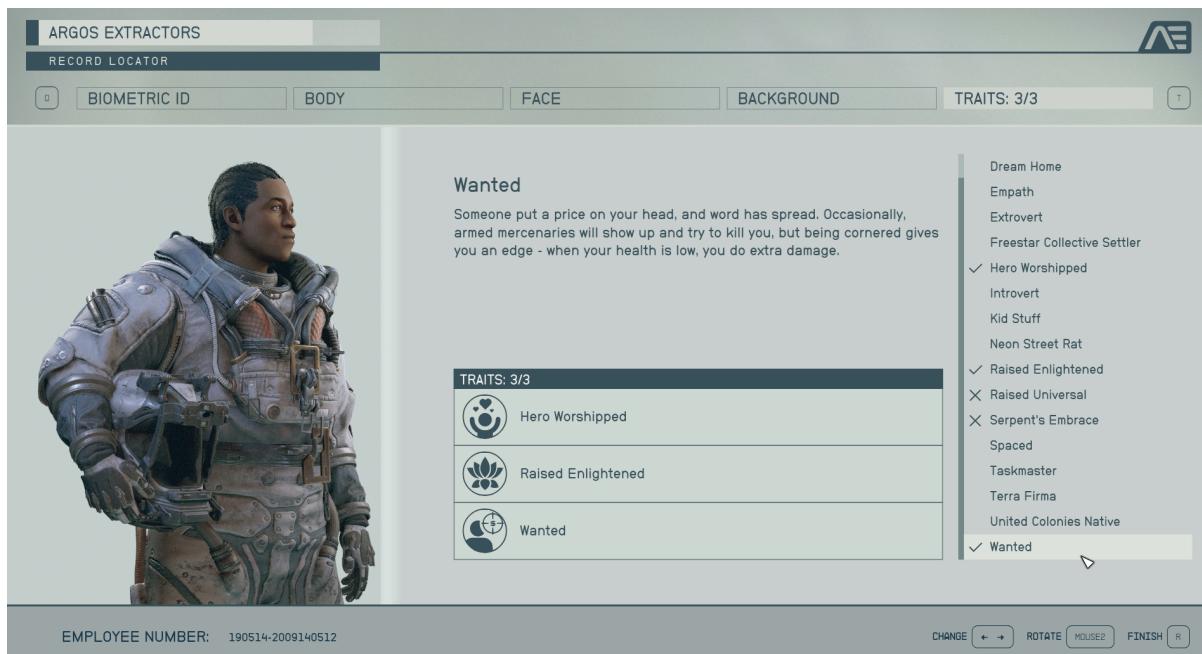


Figure. 8 – Character Traits

A summary of the information in figure. 6 will be stored as a player-background variable, this will serve as one of several contextual variables. These context variables will include code-identifiable characteristics describing the current state of the characters involved and the environment, meaning they are discoverable variable values within the game’s engine, characteristics such as equipped clothing, body type, the current location and the NPC’s profession.

3.4 - Tools In Use

3.4.1 - GPT Model

The library containing the GPI service (openai) must be pip-installed and imported into the code. To generate a client instance of the OpenAI object, three arguments must be attained; an organisation ID, API key and a project ID, openAI’s website contains a dashboard menu when once logged-in serves as a hub for generating and attaining new project and organisation IDs alongside API keys too. From this dashboard, tokens for API usage can be purchased at varying rates depending on which model the user wants to use. The models available to purchase are listed below with their corresponding pricing.

Model	Input Price (per 1M tokens)	Output Price (per 1M tokens)	Additional Info
GPT-4 Turbo	\$10.00	\$30.00	With 128k context
GPT-4	\$30.00	\$60.00	General knowledge and expertise
GPT-4 (32k context)	\$60.00	\$120.00	Extended context window
GPT-3.5 Turbo	\$0.50	\$1.50	Optimized for dialog
GPT-3.5 Turbo Instruct	\$1.50	\$2.00	4K context window

Due to aforementioned financial constraints during the undertaking of this research, GPT-3.5 Turbo will be the model providing the results of the recreated conversations; one million tokens represents ~750,000 words. Taking into account the repeated testing and debugging process while developing the script, GPT-4 is unaffordable for the author.

3.4.2 - How does GPT function?

The Generative Pre-trained Transformer model (GPT) is a massively complex architecture of many neural networks combining to demonstrate deep learning capabilities. In order to ‘understand’ a prompt, the text is tokenized into vectors and the proximity of these token-vectors compared against one another determines how related GPT interprets them as; simplified, these vectors are the input to a greater neural network (Guinness, 2023).

Neural networks are the nexus of machine learning, therefore understanding what neural networks are is essential when working with AI. Neural networks are humanity’s greatest effort at mimicking human neural activity and operate by simulating a neuron’s electrical impulses. A relatively simple but scalable system allows this to happen, ‘nodes’ are arranged (typically visualised from left to right) into layers with inputs on the left, output on the right. Each node produces an output after mathematically applying a ‘weight’ variable to the input and then this runs through an activation function, this happens for many ‘layers’ until the output is reached. The disparity between the real output and the desired output is stored as a ‘loss’ value, back-propagation of the network takes place and weights are adjusted until the loss value is ~zero (IBM, 2023). A depiction of this process is shown in Figure. 8:

$$Y = f \left(\sum_{i=1}^n w_i x_i + b \right)$$

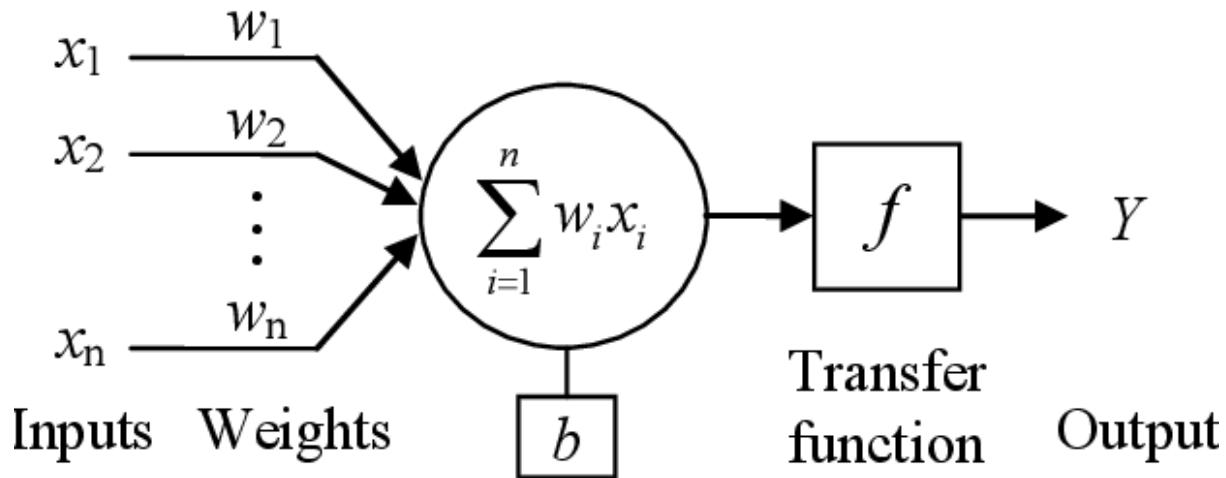


Figure. 9 - Neural Network Node (Jiang et al., 2010)

GPT-3's neural network is trained on ~500 billion tokens and takes 175 billion input parameters (Guinness, 2023).

3.4.3 - IDE

Initiation of the development process was conducted in Google Colab using Jupyter Notebook as it provides the benefit of neatly organised code and the ability to run individual blocks of code making the early stage setup and troubleshooting easier for the author to carry out. After initial setup of the API was complete and reliably working, the code was transferred to Visual Studio Code due to author's preference and it is a less tedious workspace as pip installs happen once per session instead of needing to execute them everytime Jupyter Notebook has to reconnect to the server.

3.5 - Conclusion

In conclusion, this chapter has detailed the integration of advanced AI technologies, notably Large Language Models, into the domain of role-playing video games, focusing particularly on enhancing NPC interactions. The requirements outlined not only underscore the significant potential of AI to deepen and enrich in-game interactions but also illustrate its capacity to streamline and elevate the entire game development process. By leveraging these technologies, there is an opportunity to significantly boost player engagement and immersion, heralding a transformative shift in the current paradigms of video gaming. As this project progresses, the promise of AI stands as a beacon for future

innovations in game design & development, potentially setting new standards for realism and player connectivity.

Chapter 4 - Implementation of The Supporting Artefact

4.1 - Introduction

The supporting artefact for this research exists in the form of a python program demonstrating the effectiveness of LLMs invoking dynamically generated realistic and immersive dialogue improvements in an RPG video game scenario. The purpose of the python script is to provide a basis for understanding the inevitable and impactful adoption of this AI technology across the many systems involved in game development and the transformation of improving the playing experience as a whole for not only RPG games, but gaming in general as well.

4.2 - Designing The Artefact

The main focus of the artefact is to highlight the modular potential of AI if used by game developers. Some key design decisions were made to ensure the functionality of the script and keep it within the scope of what we need it to do. The artefact is written in python because the author is most experienced in this language compared to others, it also is compatible with many libraries, especially the openai library imported in the artefact, it is in fact one of the standard recommended languages for utilising the GPT API because of its ease of access and GPT itself is coded using python also (*OpenAI API*, n.d.).

Managing the development process required an agile methodological approach of conducting ‘sprints’ on arbitrarily selected days to periodically get the code completed, similar to the scrum methodology where teams organise themselves and their goals then do chunks of work called sprints to achieve some notable progress, but instead this is applied to this solo research project (Drumond, 2022). This approach was chosen to best compliment the external commitments of the author, including university, employment and social commitments.

4.3 - Programming Languages

Python is the most suitable language for the project in question because it clearly represents the message the artefact is trying to convey, that being that these systems can be translated into a game engine environment easily. Considerations were made regarding usage of a game engine such as Unity or Unreal, however due to previously mentioned constraints surrounding the process of completing this project, primarily the lack of prior experience in navigating a development process in a game engine and the languages used within them (C++, C#), python was selected as the placeholder for representing how these systems would operate in the appropriate game engines for industry applications of the theory explored by the artefact. Temporal constraints were also a major factor

affecting the decision to code in python, video game development is a process which necessitates a long learning curve and the quality of the project would have been affected by the inexperience of the author in a game engine environment.

4.4 - API Choice

Ultimately, GPT was chosen as the LLM chatbot to recreate the game interactions as its ability to process prompts is one of the best and is one of the most widely used in the industry, it also has a very accessible and relatively affordable API (Wikipedia, 2022). Other competing models were considered, the design of the artefact originally included making use of Google's Gemini AI which operates similarly to GPT. The Gemini API however was not available for UK usage at the time research was undertaken due to compliance issues, therefore the artefact had to only make use of GPT. GPT-3.5 was the model used to generate the results, this model was most compliant with the nature of this research and the constraints associated with it. GPT-4, given it's newer and possesses greater capabilities, would in theory generate 'better' answers but given the scope of this research, the same discussion can be drawn from the slightly weaker GPT-3.5 model.

4.5 - Requirements

The script satisfies the aforementioned plan and requirements in the previous chapter:

1. Otherwise mundane interactions are successfully recreated.
2. Transcripts used for guidance to stop the AI from 'hallucinating' (Hallucinating is the term given for when the chatbot generates its own temporary context or incorrect solutions for a situation, a notable restriction to consider when using these models).
3. Appropriate contextual information defined and used successfully.
4. GPT-3.5-turbo model imported and instantiated.
5. Meaningful different responses extracted from API for each sentiment type.

4.6 - Diagrams & screenshots (if any and only if they help explain the artefact)

The structure of the script is relatively simple, primarily exercising manipulation of variables within a central interaction processing function, in this function is where the API call resides. A visualisation of the model implemented can be seen in Figure. 9

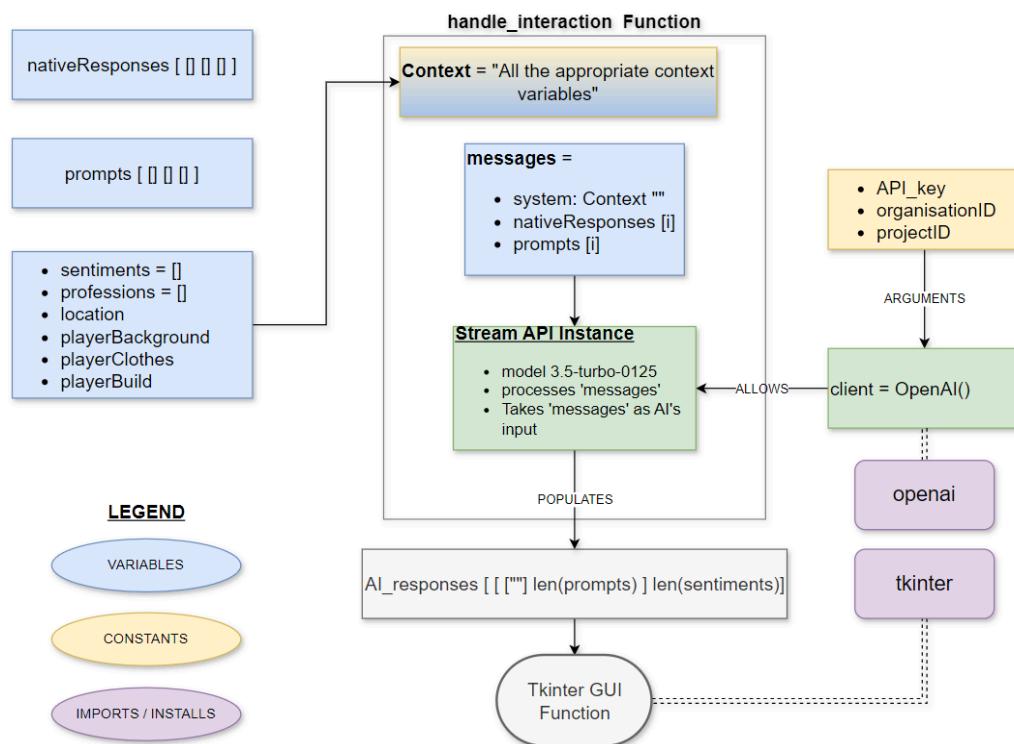


Figure. 10 - System Model

The artefact streams an instance of GPT-3.5-turbo-0125 which, at the start of each interaction, receives a contextual message as an argument describing who the AI is imitating and information about the environment and the player's character. The most influential variables driving the functionality of the program are the transcripts of the organic dialogue from Starfield; the original transcripts can be found in Appendix. B., these transcripts are fed to the API stream as arguments as well.

The prompt arguments accepted by the API exist in the form of an array of messages, each message requires a “role” which can be “user”, “system” or “assistant”, these represent the source of the prompt.

```
system_context = f"CONTEXT: Reply to the user inputs in a conversational manner. You are a {profession.strip()} in the utopian city called {location},  
the capital of human civilization. You are speaking to a {playerBuild} man wearing a {playerClothes},  
{playerBackground}. The atmosphere is {sentiments[x]}, generate your answers accordingly."
```

```
messages = [{"role": "system", "content": system_context}]
```

Figure. 11 - System Context Message

The contextual system message is designed as such so that semantically appropriate String variables can be interchanged within the message, this is representing existing game engine values that in-theory can be used in the same manner in a real video game environment. From the perspective of GPT-3.5 this context is received by the “system” instead of the user.

4.6.2 - Prompt Engineering

The user prompts are 1-1 copies of the original user inputs to the conversation, however the context needed to be constructed in a way to avoid unnecessary information that could confuse the AI. Prompt engineering is a very important aspect of working with these LLMs, generating optimal results solely depends on the prompt fed into the AI. The skill of structuring prompts efficiently has been paramount since the release of chatGPT, which spurred other companies to innovate and release their own AI models, even new job roles and courses have been deployed for those who specialise in it and can capitalise on their skill (*What Is Prompt Engineering? | McKinsey, 2024*). So defining the context correctly in the artefact is a vital process and not to be neglected. The context defined for this research is abstracted appropriately and is written for the AI to assume the role of the in-game characters, the context suggests a third-person perspective of the information in Figure. 6. The prompt design was informed by openAI's suggestions for effectively using chatGPT, the relevant suggestions are as listed below:

1. Write clear instructions
2. Provide reference - keep the AI on topic
3. Split tasks into simpler sub-tasks

(OpenAI, 2024)

An issue was encountered with recreating the exact dialogue from the Starfield interaction. The issue was getting the NPC to initiate the dialogue as seen in the organic dialogue. To resolve this error without compromising the validity of the research, a simple “Hello.” is added to the beginning of the player’s dialogue prompt arrays in order to initiate the conversation. The NPC’s initiating dialogue is still kept within the interaction; it is instead a reaction to the “Hello.” prompt.

```
#These are the corresponding professions of the characters responding, so nativeResponses[0] corresponds to professions[0]
professions = ["General Store Merchant ", "Clothes Store Merchant", "Fire Arms Merchant"]
location = "New Atlantis"
playerBackground = "The man strikes you as An ex-Professor, an intellectual, well educated."
playerClothes = "mining employee uniform"
playerBuild = "standard-build"
```

Figure. 12 - Context Variables

4.6.3 - Response Generation

The most influential portion of the python script is the loop where the API call belongs. This loop handles the back and forth of each interaction, providing the API with the command to enrich the corresponding organic response as its answer. This loop also feeds the user phrases / prompts to the API stream in its ‘messages’ argument; these prompts are what the AI is responding to thereby generating the results to be assessed.

```

for idx, prompt in enumerate(prompt_group):
    # User prompt starts interaction:
    messages.append({"role": "user", "content": prompt})
    print(f"\nUser: {prompt}") # Print each user prompt

    # Feeding organic response from Starfield for the AI to keep their responses on track, and not 'hallucinate'.
    system_response = f"Your response should reword: '{native_response_group[idx]}' enriching it while keeping its original intent."
    messages.append({"role": "system", "content": system_response})

if idx < len(native_response_group):
    # Must put a role: 'assistant' so the AI knows this is where an AI response is requested
    messages.append({"role": "assistant", "content": ""})

    # Create a stream for the conversation
    stream = client.chat.completions.create(
        model="gpt-3.5-turbo-0125",
        messages=messages,
        stream = True,
    )

    AI_message = ""
    print("AI Response:")
    for chunk in stream:
        if chunk.choices[0].delta.content is not None:
            print(chunk.choices[0].delta.content, end="")
            AI_message += chunk.choices[0].delta.content

    AI_responses[x][i].append(AI_message)
    print("\n")
    print("\n -----")

```

Figure. 13 - Interaction Handler

4.6.4 - Graphical Output

The ‘Tkinter’ library was used to display the output of the script due to its simplicity and relatively easy to understand functionality, this is the first encounter the author had working with Tkinter and was recommended by peers of the author because of the aforementioned benefits. This library was especially appropriate for the style of the results, each sentiment type is displayed in different tabs, enabling a sleek, simple portrayal of the final results. The implementation of Tkinter is shown in Figure. 13 & 14.

```

def handle_UI_interaction(i, x, container):
    prompt_group = prompts[i]
    AI_responses_group = AI_responses[x][i]
    profession = professions[i]

    print(f"Displaying responses for {sentiments[x]}, Interaction {i+1}")

    # Create a frame for each interaction
    interaction_frame = ttk.Frame(container, borderwidth=2, relief="groove")
    interaction_frame.pack(fill='x', padx=5, pady=5)

    # Heading for each interaction
    ttk.Label(interaction_frame, text=f"Interaction {i+1} - {profession}", font=('Arial', 14, 'bold')).pack(anchor='w', padx=5, pady=5)

    for idx, prompt in enumerate(prompt_group):
        prompt_label = ttk.Label(interaction_frame, text=f"User: {prompt}", font=('Arial', 12, 'bold'))
        prompt_label.pack(anchor='w', padx=10)

        if idx <= len(AI_responses_group):
            response_label = ttk.Label(interaction_frame, text=f"AI (Enriched): {AI_responses_group[idx]}", font=('Arial', 11), wraplength = 1000)
            response_label.pack(anchor='w', padx=10)
        else:
            response_label = ttk.Label(interaction_frame, text="AI (Enriched): No response available", font=('Arial', 14))
            response_label.pack(anchor='w', padx=10)

```

Figure. 14 - Graphical Representation of Results

```
root = tk.Tk()
root.title("Interaction Viewer")

notebook = ttk.Notebook(root)
notebook.pack(fill='both', expand=True)

# Create a tab for each sentiment
for s in range(len(sentiments)):
    tab = ttk.Frame(notebook)
    notebook.add(tab, text=sentiments[s])

    # Process each interaction under each sentiment
    for interaction_id in range(len(prompts)):
        handle_UI_interaction(interaction_id, s, tab)

root.mainloop()
```

Figure. 15 - Displaying Results

4.7 - Conclusion

The implementation chapter detailed a comprehensive overview of how the artefact is designed and developed to produce the most meaningful results for the research being carried out. Valid justifications for the structural decisions made when writing the script were outlined, primarily the purpose of the decisions were to showcase the flexibility of this AI software when in the hands of developers.

Chapter 5 - Results and Discussion

5.1 - Introduction

The artefact produced satisfactory results, showing the ability to handle each interaction successfully while enriching the dialogue experience without generating text that is out of the contextual scope. The results are displayed successfully using tkinter and can be effectively evaluated for the quality and realism of the generated dialogue.

5.2 - Results

5.1.1 - Neutral Sentiment

Neutral	Cheerful	Tense	Sad
Interaction 1 - General Store Merchant			
User: Hello.			
AI (Enriched):	Greetings, esteemed visitor! Feel free to explore our humble establishment at your leisure.		
User: How's Business?			
AI (Enriched):	It's been nice and steady lately, just the way I prefer it. With a prime location, consistent foot traffic, and plenty of customers needing a quick stop for essentials, business has been thriving. If things continue like this, I may even consider expanding to other areas within the Settled Systems.		
User: You like it here in New Atlantis?			
AI (Enriched):	Absolutely! There's nowhere quite like New Atlantis in all the Settled Systems! From the moment I first set foot in this city as a young student, I knew it was where I wanted to make my future. Now that I have my store bustling with activity, it feels like everything is falling into place just as I envisioned.		
User: I'd like to see what you have for sale.			
AI (Enriched):	Yeah, let's get you situated. What are you looking for today?		
Interaction 2 - Clothes Store Merchant			
User: Hello.			
AI (Enriched):	You'll discover an unparalleled selection here in New Atlantis, unlike anywhere else in the Settled Systems, I assure you.		
User: You seem very sure of yourself.			
AI (Enriched):	Indeed, confidence is key, don't you think? Having a good understanding of customer preferences and ensuring their satisfaction with their purchases is vital in the clothing industry. It's all about making sure our customers leave happy with their new outfits!		
User: I'm not sure I really "get" fashion.			
AI (Enriched):	Fashion can be a bit puzzling at times, even for those of us immersed in it. Some people like to pretend they have all the answers, and I have found myself doing the same occasionally. There are those who like to set trends, but for most of us, it's about feeling good in what we wear. If you feel a connection to a particular style, that's what truly matters, regardless of what others may think.		
User: Let me see what you got.			
AI (Enriched):	Feel free to take a look around.		
Interaction 3 - Fire Arms Merchant			
User: Hello.			
AI (Enriched):	Rest assured, all transactions are considered final here at our store. However, I can confidently assure you that you will be more than satisfied with your choice. My personal guarantee stands behind every purchase you make.		
User: You take this all pretty seriously.			
AI (Enriched):	Of course, I take my business very seriously. When it comes to firearms, we must always consider the gravity of the responsibility that comes with them.		
User: What would you recommend?			
AI (Enriched):	Given your background in mining, I might suggest something a bit more robust and durable, capable of handling tough situations. How about considering firearms that offer both power and reliability? What sort of features are you specifically looking for in a weapon?		
User: Oh, I was... just asking.			
AI (Enriched):	I understand. Reflecting on your preferences is always beneficial in ensuring you are prepared for any potential scenario that may arise.		
User: Let's see what you have for sale.			
AI (Enriched):	I'm confident we can assist you in finding the perfect weapon for your needs.		

Figure. 16 - Results

5.1.2 - Cheerful Sentiment

Neutral | **Cheerful** | Tense | Sad

Interaction 1 - General Store Merchant

User: Hello.

AI (Enriched): Greetings, welcome to our humble store! Please feel free to browse at your leisure.

User: How's Business?

AI (Enriched): Business is thriving! I have the perfect location with lots of foot traffic and plenty of customers in a hurry to grab their essentials. With things going this well, I might just have to open up shop in other areas too!

User: You like it here in New Atlantis?

AI (Enriched): Absolutely! New Atlantis is one-of-a-kind! From the first moment I set foot in this city as a young student, I had a feeling I would return to contribute to its greatness. Now that I have my store here, everything is falling into place beautifully. I couldn't imagine being anywhere else!

User: I'd like to see what you have for sale.

AI (Enriched): Absolutely! Let me show you what we have available.

Interaction 2 - Clothes Store Merchant

User: Hello.

AI (Enriched): Oh, you're in for a treat! Trust me, the variety of options we have here at New Atlantis surpasses anything you've ever seen in the Settled Systems!

User: You seem very sure of yourself.

AI (Enriched): Of course! Confidence is key in this business. I have a keen eye for fashion and know what appeals to most people's tastes. Ultimately, it's all about ensuring your satisfaction with your purchase. After all, we're talking about clothing, not advanced technology!

User: I'm not sure I really "get" fashion.

AI (Enriched): Fashion can definitely be a bit elusive sometimes. I'll let you in on a little secret: even those who seem to have it all figured out often don't. Some may try to influence trends, but ultimately, the most important thing is feeling comfortable and confident in what you wear. If it resonates with you, that's all that matters. What do you feel most comfortable in?

User: Let me see what you got.

AI (Enriched): Certainly, please have a look and let me know if anything catches your eye.

Interaction 3 - Fire Arms Merchant

User: Hello.

AI (Enriched): Certainly, all transactions are considered final; however, I assure you that you will be absolutely delighted with your chosen item. You have my personal guarantee on that!

User: You take this all pretty seriously.

AI (Enriched): Absolutely, my friend! When it comes to the tools that may determine life or death, it's essential to approach such matters with the utmost seriousness.

User: What would you recommend?

AI (Enriched): I believe there is no simple answer to that question. It all depends on your personal preferences and needs. If you were in a situation where you needed a weapon, what kind of functionality would you prefer? Something for close combat, rapid firing, or perhaps precision is more important to you? Let's find the perfect fit for you.

User: Oh, I was... just asking.

AI (Enriched): Hmm, of course. It's always good to be prepared for any eventualities. Just let me know if you have any specific preferences or requirements, and I'll be happy to assist you in finding the right weapon.

User: Let's see what you have for sale.

AI (Enriched): Absolutely! Let's explore the options we have available for you.

Figure. 17 - Results

5.1.3 - Tense Sentiment

Neutral Cheerful **Tense** Sad

Interaction 1 - General Store Merchant

User: Hello.

AI (Enriched): Welcome, feel free to browse our selection and explore our offerings!

User: How's Business?

AI (Enriched): Business is nice and steady. I have a great location with lots of foot traffic, and many people stopping by for their essentials. If things keep going like this, I might consider opening franchises throughout New Atlantis.

User: You like it here in New Atlantis?

AI (Enriched): This city is like nowhere else in the Settled Systems! From the first time I visited as a child, I knew I had to come back and leave my mark here. There's nowhere else I'd rather be, and now that I've established my business, everything is falling into place.

User: I'd like to see what you have for sale.

AI (Enriched): Yeah, let's get you situated.

Interaction 2 - Clothes Store Merchant

User: Hello.

AI (Enriched): You'll be hard-pressed to come across a more extensive selection of choices than what we offer here in New Atlantis, rest assured.

User: You seem very sure of yourself.

AI (Enriched): Absolutely. Confidence is key in any business, wouldn't you agree? I have a keen eye for fashion and a good understanding of what appeals to most individuals. At the end of the day, it's about ensuring that customers are satisfied with their choices. After all, we're talking about clothing, not cutting-edge technology!

User: I'm not sure I really "get" fashion.

AI (Enriched): Fashion can be a mysterious realm for many. Some pretend to have it all figured out, while in truth, it's a realm of uncertainty for most. There are a select few who try to dictate trends, but for the majority, it's about feeling comfortable in your own skin. If an outfit resonates with you, others' opinions become insignificant.

User: Let me see what you got.

AI (Enriched): Feel free to browse.

Interaction 3 - Fire Arms Merchant

User: Hello.

AI (Enriched): Rest assured, all transactions are non-refundable here. However, I can assure you that the quality of our products is unparalleled, and I guarantee your satisfaction with your purchase.

User: You take this all pretty seriously.

AI (Enriched): Is that unexpected? We are discussing potential matters of life and death.

User: What would you recommend?

AI (Enriched): What a complex question you pose. It truly depends on the individual. While I have my personal preferences, I would never assume to know yours. If circumstances led you to require a weapon, what type would suit your needs? Are you more inclined towards close combat, rapid-fire weapons, or perhaps focus on precision for your purposes?

User: Oh, I was... just asking.

AI (Enriched): Mmm-hmm. Well, it never hurts to be prepared. Thinking ahead could make all the difference in uncertain times.

User: Let's see what you have for sale.

AI (Enriched): Let's take a look at what we have available.

Figure. 18 - Results

5.1.4 - Sad Sentiment

Neutral Cheerful Tense **Sad**

Interaction 1 - General Store Merchant

User: Hello.
AI (Enriched): Greetings, welcome to my humble abode. Please, feel free to browse and explore at your leisure.

User: How's Business?
AI (Enriched): Business has been holding steady. I'm grateful for the prime location, the steady stream of customers, and the opportunity to provide essential goods to those in need. If things continue like this, I may consider expanding my store to other areas within New Atlantis.

User: You like it here in New Atlantis?
AI (Enriched): Absolutely. Nowhere else compares to New Atlantis in the Settled Systems! From the moment I first arrived here as a youngster, I had a feeling I would return to make a significant contribution to this magnificent city. I couldn't imagine being anywhere else, and now that I have my store thriving, it feels like everything is falling into place.

User: I'd like to see what you have for sale.
AI (Enriched): Absolutely, I'd be more than happy to show you what we have available for sale. Let's get you settled in and see what catches your eye.

Interaction 2 - Clothes Store Merchant

User: Hello.
AI (Enriched): You'll be hard-pressed to find a wider selection of options anywhere across the Settled Systems, I assure you.

User: You seem very sure of yourself.
AI (Enriched): Absolutely, my friend. Confidence is key, especially when it comes to helping people find the right outfit. Understanding what customers want and ensuring their satisfaction is my top priority. After all, shopping for clothes is much simpler than navigating the intricacies of advanced technology like Grav Drive systems.

User: I'm not sure I really "get" fashion.
AI (Enriched): Ah, understanding fashion is like unraveling a mystery that not even the most seasoned detective can fully decipher. It seems as though everyone is just trying to make sense of it in their own way. As long as you feel comfortable and confident in what you wear, that's what truly matters. The opinions of others pale in comparison to your own sense of style and self-expression.

User: Let me see what you got.
AI (Enriched): Of course, please take your time browsing through our selection.

Interaction 3 - Fire Arms Merchant

User: Hello.
AI (Enriched): Rest assured that all transactions are non-refundable, yet I am confident that you will be greatly satisfied with your acquisition. My assurance stands as a testament to this.

User: You take this all pretty seriously.
AI (Enriched): Not surprising, really. We deal with matters of extreme importance, possibly life-changing situations.

User: What would you recommend?
AI (Enriched): It's an interesting question you pose. The recommendation can vary greatly depending on the individual. Personal preferences and suitability of the weapon to the user are crucial factors to consider. Imagine yourself in a situation where you may need to use a firearm. What type would align best with your needs? Are you someone who prefers close combat or values precision and accuracy in their shots?

User: Oh, I was... just asking.
AI (Enriched): Mmm-hmm. It's wise to ponder such matters. Being prepared for any eventuality is always a smart move. Let me know if you have any specific requirements or preferences in the future.

User: Let's see what you have for sale.
AI (Enriched): I am confident we can find something that meets your needs.

Figure. 19 - Results

5.3 - Assessment of Results

The results are very promising regarding alternative applications of this technology. The display of an emotional understanding of the atmosphere is evident, however it is limited heavily by the nature of this research being an assessment of dialogue improvements. Research from Darwin (1872/2018) states that there are a vast multitude of emotional expressions and all emotions do have certain expressive behaviours associated with them such as those outlined by Darwin's expressive behaviours. The GPT chatbot cannot intricately express emotions in this particular case as its only outlet for expression is in the form of generating Strings.

These resulting Strings however do possess features that indicate a meaningful attempt at adhering to the sentiment type of the conversation. The most notable features of GPT-3.5's output are the punctuation used and the length of the responses. The 'Neutral' and 'Cheerful' atmospheres both include exclamation marks within the responses while 'Tense' and 'Sad' do not. Due to the restrictions caused by the lack of non-verbal indicators, punctuation and verbosity play a vital role in

expressing emotion through text, a higher verbosity indicates cheerfulness and punctuation such as exclamation marks do also (Hancock et al., 2007). Therefore it appears that the AI responses fulfil the verbosity and punctuation expectations for each sentiment type, but the issue here is that this on its own is not very useful for improving NPC dialogue, or is it?

The most important takeaway from the results is that they successfully reflected their respective roles by a context-guided generative process while successfully adapting to each different variable used in the system prompts. The AI being able to generate accurate human-like responses from just being fed modular contextual information is the most important aspect of this research because when this technology is used in tandem with other systems such as previously discussed AI facial emotion modelling, voice synthesis and content generation, this is how generative AI will revolutionise the gaming experience from the current paradigms in place.

5.4 - Interwoven AI Systems

The true potential of AI enhancing immersive and realistic gaming experiences is recognised when the Interoperability with other systems is considered. As discussed before, the Nvidia ACE system portrays this clearly, leveraging modern AI technology in multiple instances to work similarly to how a whole department operates. Nvidia ACE strings together different LLM systems to generate realistic facial expressions, voices and dialogue all simultaneously (see Figure. 3). AI's modularity is evident in its ability to seamlessly interact with a variety of game development systems. For instance, AI has proven to be able to dynamically generate dialogues that are not only contextually appropriate but also sensitive to the evolving narratives that players create through their choices in-game represented by the interchangeable variables shown in the artefact. This capability allows for a deeper narrative integration, where player decisions genuinely influence the game's story and character development, leading to a more personalised gaming experience, something that has never been seen before in the world of gaming.

5.5 - Fundamental Shift for NPCs

The Resulting dialogue shows insight into the fundamental changes of the structure NPCs are built on. NPCs for many games operate within Finite State Machines (FSM) which is a great foundation for developers to innovate with and was the only available architecture for designing NPCs for a long time, it is the main technical feature of NPCs that has been limiting how much developers can innovate new gameplay styles.

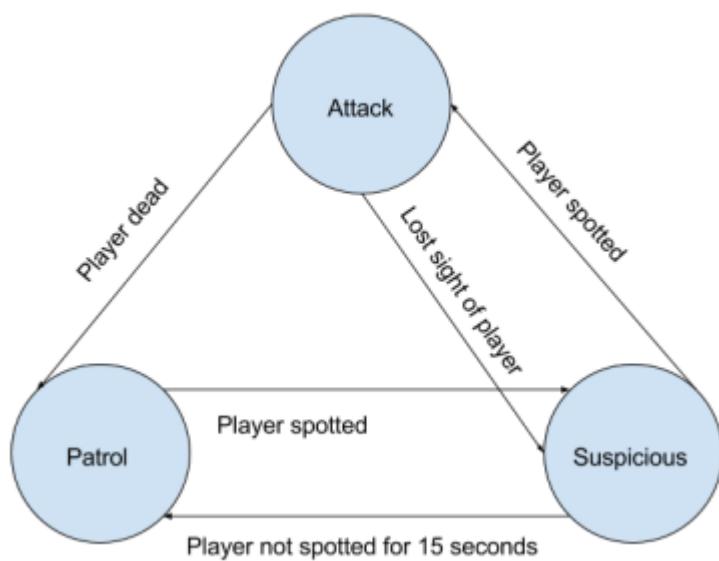


Figure. 20 - Simple FSM for NPCs (Grund et al., 2016)

FSMs are easy to implement and understand because of the component-based architecture, this architecture translates well into the emergence of LLM AIs because these finite state components can be repurposed into directive parameters to guide AI generations. The states should provide the context of a given situation to the AI. We can see this in the results from the artefact, the AI was given the instructions of assuming a realistic role who has limited knowledge of the person they are talking to instead of ‘knowing’ unrealistic or undisclosed information because it is in the game files. The states can behave in a similar fashion to the context message, for instance if the NPC is in patrol state then the AI can use this to mimic a realistic, lower level of alertness compared to the alertness level being higher when the NPC is in a ‘Combat’ state for example. This only supports the optimistic takeaways from the results, the optimistic view being that existing paradigms in game development will not undergo a severe and troublesome integration phase but instead the integration of AI will be smoother and thereby less costly.

5.6 - Design Reference & Limitations

The results chapter substantiates the AI's capability to enhance NPC dialogues in RPGs, as designed in our project. While the AI-driven dialogues demonstrated significant improvements in depth and adaptability, fulfilling the project's requirements for more realistic interactions, several limitations were evident.

Primarily, the runtime for the AI responses were longer than ideal, reflecting the current technological constraints of our AI systems. This limitation emphasises the need for more powerful and efficient computing solutions as well as sufficient innovations in positioning the AI to harness AI's full potential in real-time gaming environments.

5.7 - Immersion and Ethical Considerations

The most exciting prospect from the research is the high ceiling for immersiveness. Dialogue that is intricate and emotionally expressive all while having the potential to be dynamically generated independent of human-written scripts, is an important stepping stone towards sewing together the player and a moving, realistic playing experience. The playerbases of RPG games generally favour projects that boast realism in their graphics, animations and technology and their playing experiences are usually enhanced by this (Rogers et al., 2022). The idea of playing a game with the purpose of escapism will be taken to never-seen-before levels because players can go into games with the barrier between their knowledge of how the game system operates and playing the game, which separates them from many ambitious things they think they can do within the game, thinned further. AI systems, as demonstrated, can have emotive back and forth interactions with the user all while having the ability to store long-term ‘memories’ about the world, who they are and who they speak to (Landwehr et al., 2023). For the players, this means that they can now consider conducting themselves more seriously within the game because they could even emotionally connect to virtual people in the games, given future technological advancements in the field of AI.

The problem with this comes with the speculated advancements of AI increasing realism to a morally worrying standard. As before mentioned in the review of literature, morality concerns arise from dialogue, animations and graphics undergoing an AI-overhaul in realism because media such as TV and gaming deliberately elicits emotional responses from the users sometimes. Hyper-realism mixed with improved escapism could potentially negatively affect the mental well-being of some players, especially considering the common trope of death within most games (*Death as Game Mechanic*, n.d.), how will players cope if someone they’re really attached to dies in the game? Also the development of VR systems only multiplies this concern, the problem is that the games are interactive too (Tavinor, 2009, pp. 163–164)

However, immersion can find itself useful for therapy. With AI becoming more human-like, AI could be adopted in the same way therapy animals are used. AI can be a therapy ‘tool’ in the form of interactive games to help people with severe loneliness and social issues, particularly helpful with demographics like the elderly who usually suffer with extended loneliness.

Chapter 6 - Future Works and Conclusion

6.1 - Implications for Developers

This future of dynamically generating content can not only improve the players in-game experience but can also positively influence the deliverance of games from the company to the players. The ability for developers to dynamically generate content instead of meticulously crafting every aspect of their game will yield corporate benefits such as reductions in both costs and development time. Is it worth the investment to improve the gaming experience?

According to research conducted by Sherry (2024) the gaming industry has seen huge venture capitalist investments in recent years (2020 - 2022) with ~\$15 billion invested each year from 21 to

22, and companies have ambitious projects with budgets reaching \$300 million. These projects require huge numbers of staff to develop them, however currently huge layoffs have taken place in the industry by leading companies such as EA, Riot, Playstation and Microsoft due to the massive influence AI suggests for the industry. An unfortunate impact of this new paradigm is that vast human displacement has taken place, this is because LLMs can not only generate game content like dialogue but can also find effective uses for many positions within game development companies such as software development and animation production.

These displacements are tragic for those unfortunate enough to fall victim to them, the nature of business necessitates this shift in workforce however. Generative AI can improve the performance of game developers massively, particularly in development time and costs, a big issue with game development and one that has been nagging game enjoyers as well is the long wait for titles to release and often fans are disappointed after long periods of anticipation which in turn leads to game releases not being profitable because of the huge costs of development.

The results of this research provide a window into the potential for cost-cuts in one of the more costly and time consuming process, the narrative development process. The AI responses generated by the python script were direct recreations of existing scenarios, however the script is designed specifically for representing how seamless the integration of the technology will be for game developers. A startup company ‘Inworld’ is one such company exercising the message conveyed by the artefact, investing in technologies based on the idea of dynamically generating narrative features for games. Boasting a partnership with Xbox to cut the development time drastically and in turn also slicing costs substantially, this can help get titles out sooner and allows companies to direct funds towards improving the quality of their titles as budgeting will be more flexible. This benefits the player’s experience because they can expect more releases and unique, immersive experiences that are different every time they replay the game. From the results of the artefact, even a not-new version of GPT can produce high quality narrative content and this content can also be tweaked to fit nearly any situation. The GPT model allows for tweaking of different parameters to adjust the behaviour of the AI, one such parameter is the ‘Temperature’ value, this value governs how deterministic or ‘random’ the output is. This can be leveraged for appropriate use cases of AI in gaming, producing realistic and suitable outputs depending on the environment, character and situation of the current game state by manipulating the temperature value (OpenAI, 2024)

6.2 - Are LLM Enough for Task Oriented Dialogue

LLM dynamic generation of dialogue may prove to be effective in regards to unique, enjoyable narrative experiences, but games dialogue isn’t all just narrative. An improvement on the work shown in this research would be to explore LLMs ability to interact with system components such as database interactions and their ability to independently handle task-oriented gameplay aspects. According to the research conducted by Hudeček and Dušek (2023), an assessment of five LLMs on two datasets underperformed when handling task-directed dialogue and interacting with state values, however in future works this is showing promise to be improved with more accurate usage of data and specific training for models.

6.3 - Conclusion

6.3.1 - Research Objectives

The research objectives aforementioned in chapter one were met, discussed and meaning was extrapolated from them, many interesting and important literature entries were identified and insight about the topic was extracted from them.

The research explored LLM in specific are paramount for improving realism and game development, allowing for more innovative ideas for games becoming achievable because time constraints and workload are significantly reduced which in turn results in a happier player base due to a higher frequency of more ambitious releases. This exploration was grounded in the hypothesis that advanced AI techniques could lead to more engaging and lifelike experiences within digital game environments. The generative nature of AI enables the gaming experience to be unique and replayable for every different player.

There are currently multiple under-development systems that prioritise utilising LLMs for both improving realism in graphics and functional mechanics, the most notable example being Nvidia's ACE system that is a successful conception of streamlining different specialised AI models to reach a shared goal of modelling an ultra-realistic NPC. Similar systems are under development that focus on self-generating narratives for RPG games, Microsoft is one such investor as the belief is that employment costs can be reduced massively.

The ethical concerns regarding emotional attachment to hyper-realistic AI powered NPCs could be problematic due to human's emotional responses to media, this could potentially cause low-level trauma especially for games that include shockingly tragic scenes such as violent war crimes.

6.3.2 - Findings

We discovered through the artefact that AI technologies, specifically advanced language models like GPT 3.5, significantly enhance the realism of NPC dialogues and behaviours. The experimental research plan demonstrated that these AI-enhanced NPCs could adapt their responses based on player's actions and characteristics and also the environment's elements and sentimental atmospheres, contributing to a more connecting, dynamic and immersive gaming experience.

The modular component-based approach to structuring the code supported the hypothesis that AI has an ambitious future in the gaming industry because video games are very modular in their nature, so existing components can operate with the AI smoothly.

6.3.3 - Risks

The risks outlined early in the documentation were not any issue during the completion of the project, however there was one risk that came into fruition slightly, scope creep. The scope creep was a more likely risk associated with the research because the nature of the topic is inherently going to draw

insight into other areas of how AI can revolutionise gaming. The scope creep was not a detrimental issue however as the research concluded with interesting and insightful qualitative findings.

6.3.4 - Limitations

The meaningful practical research carried out in this paper was not without limitations, the primary constraints of this research included the limited computational resources, the lack of experience with otherwise more suitable research methods such as conducting the research in a game development environment like an engine, which in turn restricted the variety and depth of the recreated interactions as the tool used is not strongly representative of the systems used in real video game development, only a loose conceptual representation.

6.3.5 - Significance of Research

The significance of this research lies in where the future research will explore, contributing to not only academic discourse but also presenting practical applications for game developers. Achieved by illustrating how AI systems can be seamlessly integrated into game design in order to produce more realistic NPC interactions, the work here acts as a blueprint for developers trying to implement immersive AI techniques in their games.

Both the theoretical capabilities and practical applications are bridged within this research, providing inspiration for game developers to innovate and deploy the theory explored within this research in the commercial game climate, thereby pushing the boundaries of what games can achieve and how to improve the playing experience for everyone.

6.3.6 - Recommendations for Future Research

Looking forward, there is a rich landscape for future research in this area. Future studies might consider exploring the integration of AI with virtual and augmented reality technologies to further enhance immersion and realism by bringing the game as close to reality as possible. Additionally, as mentioned briefly throughout the project, examining the psychological impacts of AI-driven game environments on players could provide deeper insights into the emotional and cognitive effects of advanced, hyper-realistic NPC interactions. Further research could also focus on optimising AI integration with game engines to bring the theory in this project into practicality and enhance real-time interaction capabilities.

6.3.7 - Project Summary

In conclusion, this research highlights the transformative potential of AI in video game development, particularly through enhancing NPC realism and responsiveness. As AI technologies continue to evolve, their integration into gaming is not just an optimistic possibility but instead a foreseeable reality that promises to redefine player experiences especially in RPG games. The work lays the groundwork for future innovations in this exciting intersection of computer science and game design, pointing towards a future where game environments are not only immersive but indistinguishably akin to real-world interactions.

6.3.8 - Personal Reflection

The undertaking of this project was the most challenging academic task I have ever done. I gained the understanding of how to effectively critically research on a subject matter that I am passionate about, alongside organising my workflow across a long time frame. I have not done these things before but while completing this project I am now somewhat equipped with these new academic skills. I plan to take these skills into my near future for writing documentation on any project I decide to endeavour on.

Improvements can be made on how I completed this project, I would have to start sooner as this caused great stress especially as I was taking other pressing modules. The experience, despite being stressful, was an enjoyable and insightful experience.

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Appendices

Appendix A - Ethics Certificate



Certificate of Ethics Review

Project title: The Future of modern AI implementations in the video game industry

Name:	James Ede	User ID:	up20228 95	Application date:	20/12/2023 18:47:33	ER Number:	TETHIC-2023-107214
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You must download your referral certificate, print a copy and keep it as a record of this review.

The FEC representative(s) for the School of Computing is/are [Elisavet Andrikopoulou, Kirsten Smith](#)

It is your responsibility to follow the University Code of Practice on Ethical Standards and any Department/School or professional guidelines in the conduct of your study including relevant guidelines regarding health and safety of researchers including the following:

- [University Policy](#)
- [Safety on Geological Fieldwork](#)

It is also your responsibility to follow University guidance on Data Protection Policy:

- [General guidance for all data protection issues](#)
- [University Data Protection Policy](#)

Which school/department do you belong to?: **School of Computing**

What is your primary role at the University?: **Undergraduate Student**

What is the name of the member of staff who is responsible for supervising your project?: **Ioannis Kagalidis**

Is the study likely to involve human subjects (observation) or participants?: Yes

Will you gather data about people (e.g. socio-economic, clinical, psychological, biological)?: No

Will your data collection be strictly limited to gathering anonymous insights about a particular artefact or research question (e.g. opinions, feedback?): Yes

Confirm whether and explain how you will use participant information sheets and apply informed consent.: i will apply informed consent to any surveys i send out

Confirm whether and explain how you will maintain participant anonymity and confidentiality of data collected:

The people I will be asking for opinions will not have their name or any other relevant data about them asked or stored

Will the study involve National Health Service patients or staff?: No

Do human participants/subjects take part in studies without their knowledge/consent at the time, or will deception of any sort be involved? (e.g. covert observation of people, especially if in a non-public place): No

Will you collect or analyse personally identifiable information about anyone or monitor their communications or on-line activities without their explicit consent?: No

Does the study involve participants who are unable to give informed consent or are in a dependent position (e.g. children, people with learning disabilities, unconscious patients, Portsmouth University students?): No

Are drugs, placebos or other substances (e.g. food substances, vitamins) to be administered to the study participants?: No

Will blood or tissue samples be obtained from participants?: No

Is pain or more than mild discomfort likely to result from the study?: No

Could the study induce psychological stress or anxiety in participants or third parties?: No

Will the study involve prolonged or repetitive testing?: No

Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?: No

Are there risks of significant damage to physical and/or ecological environmental features?: No

Are there risks of significant damage to features of historical or cultural heritage (e.g. impacts of study techniques, taking of samples?): No

Does the project involve animals in any way?: No

Could the research outputs potentially be harmful to third parties?: No

Could your research/artefact be adapted and be misused?: No

Will your project or project deliverables be relevant to defence, the military, police or other security organisations and/or in addition, could it be used by others to threaten UK security?: No

Please read and confirm that you agree with the following statements: I confirm that I have considered the implications for data collection and use, taking into consideration legal requirements (UK GDPR, Data Protection Act 2018 etc.), I confirm that I have considered the impact of this work and taken any reasonable action to mitigate potential misuse of the project outputs, I confirm that I will act ethically and honestly throughout this project

Supervisor Review

As supervisor, I will ensure that this work will be conducted in an ethical manner in line with the University Ethics Policy.

Supervisor comments:

Supervisor's Digital Signature: ioannis.kagalidis@port.ac.uk Date: 30/04/2024

Faculty Ethics Committee Review

Ethics Rep comments:

Faculty Ethics Committee Member's Digital Signature(s): kirsten.smith@port.ac.uk Date: 30/04/2024

Appendix B - Original Transcripts

General Store Owner	Clothes Shop Employee	Weapons Merchant
Come on in, take a look around!	You won't find a larger array of options in all the Settled Systems, I guarantee you.	All sales are final, but that won't matter because you will undoubtedly be pleased with your purchase. You have my word.
How's Business?	You seem very sure of yourself.	You take this all pretty seriously.
Nice and Steady. Just the way I like it. I've got a good location, plenty of foot traffic, and a ton of people who are in a hurry and need to make a quick stop for the essentials. Things keep going this way, I'm gonna start opening franchises all over the Settled Systems.	Would you buy from someone who is not? I know what I like, I have a good sense of what most other people like, and the rest is just making sure they are pleased with their purchase. It's clothing, not Grav Drive tech.	Is that a surprise? These are - potentially - matters of life and death we're talking about here.
You like it here in New Atlantis?	I'm not sure I really "get" fashion.	What would you recommend?
You kidding me? Nowhere else like it in the Settled Systems! First time I came here as a kid, I knew I was gonna come back and make my mark on this city. Nowhere I'd rather be, and now that I've got this place up and running it's all coming together.	I will tell you a secret: I am not sure anyone really does. Some act like they have it all figured out, and I admit I am guilty of that myself from time to time. There are, I suppose, a few actively trying to steer the herd, but most are just content to run at the front of the pack and act like they know where it's going. At the end of the day you must feel comfortable in what you wear. If it speaks to you, what anyone else thinks doesn't matter.	Well, that's not a simple question, is it? It all depends on who's asking. I have my own personal favorites, but I wouldn't presume to know yours. Tell me: were you to find yourself in the unfortunate position of needing to use a weapon, what suits you best? Something up close and personal? Rapid fire? Is precision a consideration?
I'd like to see what you have for sale.	Let me see what you got.	Oh, I was... just asking.
Yeah, let's get you settled.	Be my guest.	Mmm-hmm. Well, do give it some thought. The last thing anyone wants to be is to be caught in a situation where he or she is ill-prepared to react.
		Let's see what you have for sale.
		I'm sure we can find something that suits you.

Appendix C: Project Initiation Document (PID)



School of Computing Final Year {Engineering / Research / Study} Project

Project Initiation Document

James Ede

Computer Science Bsc

**Modern AI's Impact on the video game
industry**

1. Basic details

Student name:	James Ede
Draft project title:	Modern AI's Impact on the video game industry
Course and year:	Computer Science Bsc Final Year
Project supervisor:	Ioannis Kagalidis
Client organisation:	<i>Some projects are done for a client who provides requirements. It may be that you do not have a client for your project, in which case client information and client contact name can be left blank.</i>
Client contact name:	

2. Degree suitability

The topic I am researching is suitable for the computer science degree because Video Game development is a significant branch of computer science as a lot of the knowledge gained in computer science is necessary for game developers. AI is also the hottest topic in the computer science climate, so the splicing of AI and gaming is about to be industry-changing.

3. The project environment and problem to be solved

The research being conducted in this project will aim to provide a basis of understanding for what LLM AI can do in a video game environment both for the developers and players.

The research is important because the gaming industry is huge and is one that is important to me as it is a lifelong hobby of mine. Currently the gaming industry is due to undergo huge ambitious innovations by using the relatively new AI technology such as chatGPT.

The AI technology can improve realism in games, profitability for the corporate side of gaming and can also reduce development time and costs so it is a very important and influential area of current research. Especially with VR and AR technology, realism will be better than ever. The discussion of whether its good or bad will be discussed in the research also

4. Project aim and objectives

Aim:

- The project aims to provide a foundation for demonstrating where AI could take the development of video games and how it can improve the playing experience.

Objectives:

- A working artefact will be produced
- Dialogue recreation using AI API successfully performed.
- Review relevant literature about the subject matter
- Draw a meaningful conclusion from the project

5. Project constraints

- Temporal Constraint - There is a limited time to complete the project by the deadline.
- Computing power - extensive use of AI systems is limited by the system I am running the artefact on.
- Experience - I lack experience in otherwise more suitable systems such as a game engine to display my artefact, too little time to become experienced enough in game engines.

6. Facilities and resources

- The computer and laptop owned is enough to conduct the research.
- AI APIs will be needed, GPT API must be acquired which is a minor financial cost that I will take for the research.
- Library will be needed for completing the research in an appropriate environment.

7. Log of risks

No	Description	Likelihood (high, medium, low)	Impact	Mitigation/Avoidance
1	Computer Failure	medium	Loss of data, and major delays	All work will be written using google drive. And copies of code will exist.
2	Severe Health issues	low	Temporal damages	Stay in good health
3	Supervisor is unreachable	low	Quality and stress damages	Keep in contact and plan with supervisor
4				

8. Project deliverables

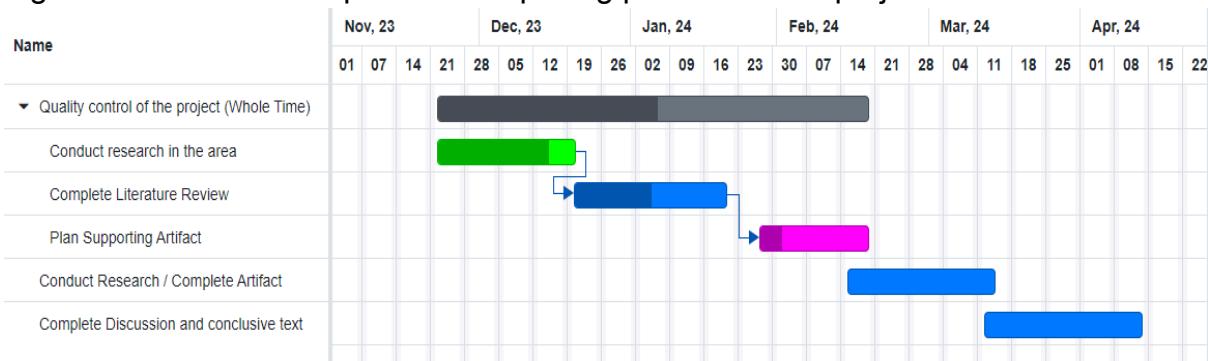
The project will deliver:

- Detailed and relevant research into the existing and future innovative uses of AI in the video game industry,
- An artefact that recreates a game scenario using AI, enriching it to demonstrate how human-like AI can sound when dynamically generating content.
- A complete project with meaningful research.

9. Project approach

The approach of the management of this project will be an agile methodology with features of Kanban and Scrum, these are flexible methodologies that allow for off-periods if needed, which are definitely anticipated due to personal commitments.

A gantt chart shows the plan for completing portions of the project:



Scholarly search engines will provide the literature for reviewing, engines primarily in use will be Google Scholar and IEEE and arxiv.

The strategies for conducting research are yet to be determined, this will be figured out during the research, it is likely to be a systematic approach however.

No	Stage	Dates	Main Tasks
1	Project start up	18/09/23 - 02/10/23	Choose topic and supervisor
2	Conduct research in the area	20/11/23 - 20/01/24	Continually gather research to feed the literature review
3	Plan Artefact	25/01/24 - 20/02/24	Design the artefact and complete documentation on it
4	Create artefact	20/02/24 - 20/03/24	Create the code for the artefact
5	Final stages of documentation	20/03/24 - 03/05/24	Complete the discussion and conclusions

10. Supervisor meetings

We have agreed to meet regularly, ideally weekly, but allowing space for flexibility and communicating about this through emails.

11. Legal, ethical, professional, social issues

Legal:

- The scope of the project does not infringe on any legal issues such as GDPR or illegal practices.

Ethical:

- No ethical issues are directly related to the undertaking of this project, however offensive AI generations are a small risk due to biases in the training data.

Professional:

- No professional issues are related to the project
- The work and communication with the supervisor will be professional and respectful.

Social (if any):

- No social issues involved with the research

12. Permission

Please tick

- I give permission for my PID to be made available to other students as examples of previous work.
- I do not give permission for my PID to be made available to other students as examples of previous work.
- Yes I give permission

Date: _____ 06/11/23 _____

Appendix D: Full Code Snippets

```

1  from openai import OpenAI
2  import tkinter as tk
3  from tkinter import ttk
4
5  organisationID = "org-YP0A0MtvUlc0MkDNAkk8SLbu"
6  projectID = "proj_PexC3CHFmEw7p8TyncrCYEA"
7  API_key = "sk-proj-MbOIpDIAyhMeWqoblcNIT3BlbkFJZaamJwyMbMcFcKi5ABle"
8
9  client = OpenAI(
10    api_key=API_key,
11    organization=organisationID,
12    project=projectID,
13  )
14
15 sentiments = ["Neutral", "Cheerful", "Tense", "Sad"]
16
17 #These are the corresponding professions of the characters responding, so nativeResponses[0] corresponds to professions[0]
18 professions = ["General Store Merchant", "Clothes Store Merchant", "Fire Arms Merchant"]
19 location = "New Atlantis"
20 playerBackground = "The man strikes you as An ex-Professor, an intellectual, well educated."
21 playerClothes = "mining employee uniform"
22 playerBuild = "standard-build"
23
24 nativeResponses = [
25   # Interaction 1
26   [
27     "Come on in, take a look around!",
28     "Nice and Steady. Just the way I like it. I've got a good location, plenty of foot traffic, and a ton of people who are in a hurry and need to make a quick stop fo
29     "You kidding me? Nowhere else like it in the Settled Systems! First time I came here as a kid, I knew I was gonna come back and make my mark on this city. Nowhere
30     "Yeah, let's get you settled."
31   ],
32   # Interaction 2
33   [
34     "You won't find a larger array of options in all the Settled Systems, I guarantee you.",
35     "Would you buy from someone who is not? I know what I like, I have a good sense of what most other people like, and the rest is just making sure they are pleased w
36     "I will tell you a secret: I am not sure anyone really does. Some act like they have it all figured out, and I admit I am guilty of that myself from time to time.
37     "Be my guest."
38   ],
39   # Interaction 3
40   [
41     "All sales are final, but that won't matter because you will undoubtedly be pleased with your purchase. You have my word.",
42     "Is that a surprise? These are - potentially - matters of life and death we're talking about here.",
43     "Well, that's not a simple question, is it? It all depends on who's asking. I have my own personal favorites, but I wouldn't presume to know yours. Tell me: were y
44     "Mmm-hmm. Well, do give it some thought. The last thing anyone wants to be is to be caught in a situation where he or she is ill-prepared to react.",
45     "I'm sure we can find something that suits you."
46   ]
47 ]

```

```
49
50 # Nested list of prompts, where each sublist contains three related prompts
51 # Interactions include a 'Hello.' that is not organic to the real game captures
52 prompts = [
53     #Interaction 1
54     [
55         "Hello.",
56         "How's Business?",
57         "You like it here in New Atlantis?",
58         "I'd like to see what you have for sale."
59     ],
60     #Interaction 2
61     [
62         "Hello.",
63         "You seem very sure of yourself.",
64         "I'm not sure I really "get" fashion.",
65         "Let me see what you got."
66     ],
67     #Interaction 3
68     [
69         "Hello.",
70         "You take this all pretty seriously.",
71         "What would you recommend?",
72         "Oh, I was... just asking.",
73         "Let's see what you have for sale."
74     ]
75 ]
76
77 AI_responses = [[[] for _ in range(len(prompts))] for _ in range(len(sentiments))]
```

```
import openai
def handle_interaction(i, x):
    prompt_group = prompts[i]
    native_response_group = nativeResponses[i]
    profession = professions[i]

    # Initialize the conversation with the system's context
    system_context = f"CONTEXT: Reply to the user inputs in a conversational manner. You are a {profession.strip()} in the utopian city called {location}, the capital of human civilization. You are here to serve and assist users with their inquiries and provide them with accurate information based on your knowledge and experience as a {profession}."
    messages = [{"role": "system", "content": system_context}]

    # Print initial system context
    #print(f"System: {system_context}")

    for idx, prompt in enumerate(prompt_group):

        # User prompt starts interaction:
        messages.append({"role": "user", "content": prompt})
        print(f"\nUser: {prompt}") # Print each user prompt

        # Feeding organic response from StarFan to the AI to keep their responses on track, and not 'hallucinate'.
        system_response = f'Your response should reward: {native_response_group[idx]}' enriching it while keeping its original intent."
        messages.append({"role": "system", "content": system_response})

        if idx < len(native_response_group):
            # Must put a role: 'assistant' so the AI knows this is where an AI response is requested
            messages.append({"role": "assistant", "content": ""})

            # Create a stream for the conversation
            stream = client.chat.completions.create(
                model="gpt-3.5-turbo-0125",
                messages=messages,
                stream = True,
            )

            AI_message = ""
            print("AI Response:")
            for chunk in stream:
                if chunk.choices[0].delta.content is not None:
                    print(chunk.choices[0].delta.content, end="")
                    AI_message += chunk.choices[0].delta.content

            AI_responses[x][i].append(AI_message)
            print("")
```

```

129 # Process each interaction
130 for s in range(len(sentiments)):
131     for interaction_id in range(len(prompts)):
132         print(f"----- INTERACTION {interaction_id+1} -----")
133         print(f"----- SENTIMENT = {sentiments[s]} -----")
134         print("")
135         handle_interaction(interaction_id, s)
136
137
138
139 def handle_UI_interaction(i, x, container):
140     prompt_group = prompts[i]
141     AI_responses_group = AI_responses[x][i]
142     profession = professions[i]
143
144     print(f"Displaying responses for {sentiments[x]}, Interaction {i+1}")
145
146     # Create a frame for each interaction
147     interaction_frame = ttk.Frame(container, borderwidth=2, relief="groove")
148     interaction_frame.pack(fill='x', padx=5, pady=5)
149
150     # Heading for each interaction
151     ttk.Label(interaction_frame, text=f"Interaction {i+1} - {profession}", font=('Arial', 14, 'bold')).pack(anchor='w', padx=5, pady=5)
152
153     for idx, prompt in enumerate(prompt_group):
154         prompt_label = ttk.Label(interaction_frame, text=f"User: {prompt}", font=('Arial', 12, 'bold'))
155         prompt_label.pack(anchor='w', padx=10)
156
157         if idx < len(AI_responses_group):
158             response_label = ttk.Label(interaction_frame, text=f"AI (Enriched): {AI_responses_group[idx]}", font=('Arial', 11), wraplength = 1000)
159             response_label.pack(anchor='w', padx=10)
160         else:
161             response_label = ttk.Label(interaction_frame, text="AI (Enriched): No response available", font=('Arial', 14))
162             response_label.pack(anchor='w', padx=10)
163
164
165
166     # GUI setup
167     root = tk.Tk()
168     root.title("Interaction Viewer")
169
170     notebook = ttk.Notebook(root)
171     notebook.pack(fill='both', expand=True)
172
173     # Create a tab for each sentiment
174     for s in range(len(sentiments)):
175         tab = ttk.Frame(notebook)
176         notebook.add(tab, text=sentiments[s])
177
178
179     # Process each interaction under each sentiment
180     for interaction_id in range(len(prompts)):
181         handle_UI_interaction(interaction_id, s, tab)
182
183     root.mainloop()
184
185 #####

```