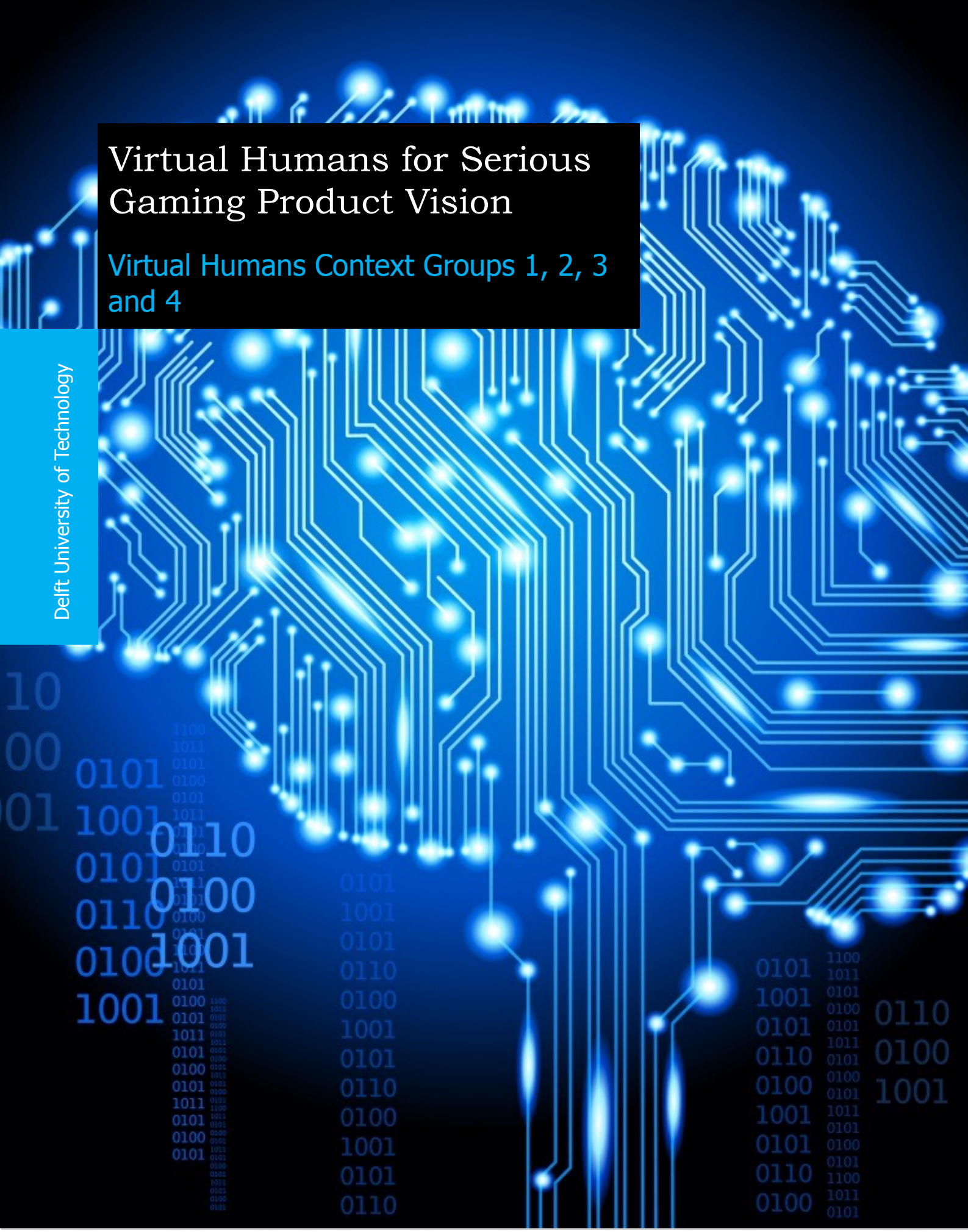
Virtual Humans for Serious Gaming Product Vision

Virtual Humans Context Groups 1, 2, 3 and 4



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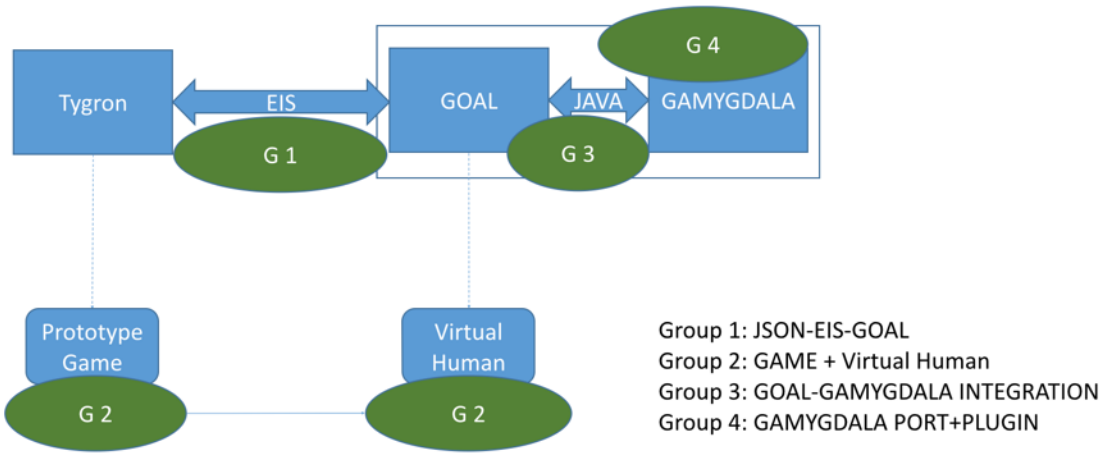
Introduction

This product vision document contains a description of our target customers and their needs, a description of the most notable elements of the product, a comparison with existing products and the time- and budget frame of the project. Our product consists of the following parts: a (set of) virtual agent(s) that can interact with each other in a complete simulation of the urban planning process without the participation of human players in the Tygron game, a version of the Tygron game that these agents will play, a bridge between GOAL and the Tygron game's interface, a version of GOAL that has the GAMYGDALA engine integrated, and a modular GAMYGDALA plugin that can be used with current unmodified versions of GOAL. Our aim is to develop agents whose responses are closest to how a real human would act in the Tygron[1] game as we can achieve within the timeframe of the project. To achieve this we will develop the interfaces necessary to facilitate all communication between GOAL agents, the GAMYGDALA engine and the Tygron game that is required to enable these agents to interact with the game and each other.

This product vision encompasses every aspect of the Virtual Humans for Serious Gaming Contextproject, because all groups implement a part of the project that does not work on its own, but rather is part of a whole. Therefore, the end product will be the result of the collaboration of all groups.



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Target Customer

During this project, we have to fulfill the needs of three different stakeholders who all have an interest in serious gaming. In this section we will describe each stakeholder and its needs.

2.1. Tygron

Tygron is the company that develops the engine our agent should interact with, whose business model is to support and supplement city planning by allowing stakeholders of urban planning projects to experiment with different scenarios in a realistic 3D environment. This tool can be used by different parties involved in urban city planning to reduce the time and effort expenditure in the planning phase, to prevent or resolve conflicts and overall increase the return on investment of these projects.

Currently, all the different roles in this serious game need to be played by actual humans sitting at a table playing the game with each other. Tygron would like to be able to replace one or more of these human players with a virtual human player in some game sessions, because negotiating a time slot in which all parties can be present to play the Tygron game can be difficult. In a future iteration of our product, virtual humans could take the place of several but not all players, allowing the human players to experiment, practice and plan while playing with virtual agents, and negotiate useful solutions for city designs and development projects even if not all parties involved have a player present for the session. A virtual human will save many hours and streamline the creation of iterations of preferred development strategies, increasing the value of Tygrons product.
The virtual humans we develop will be built only for sessions in which every player is a virtual human, since developing a wide range of natural interactions with human players is too big of a challenge. With these simulations, many new solutions to urban planning problems can be generated very rapidly. Virtual humans will in this way enable players to start looking at solutions right away and discuss them.

Tygron is the main customer for our final product.

2.2 Koen Hindriks

GOAL[2, 3] is an agent programming language for programming rational agents. Koen Hindriks is closely connected to the development of GOAL. He promotes GOAL for use in the area of serious gaming for belief- and goal-based AI. He is one of the leaders of this project, which means he has an interest in the successful completion of this project. He would like the project to provide the technology for creating virtual humans in the Tygron serious game by developing GOAL agents that can play the game reasonable well through Tygron's web interface, which uses a JSON API.

He is also interested in integrating emotions rendered by the GAMYGDALA engine to provide emotions to agents based on events in the game, so the behaviour of our virtual players might by virtue of emotion more closely approximate real human players.

2.3. Joost Broekens

GAMYGDALA is an easy to use emotion engine for games. It enables developers to simulate emotions for NPCs in virtual environments when it is provided with goals and events. Joost Broekens is one of the main researchers working on GAMYGDALA, which was developed to provide emotions to goal-oriented agents. It is within his interests to see GAMYGDALA deployed with GOAL to provide agents for the Tygron game, because it is “designed to be psychologically grounded, modular and efficient”, as stated by Popescu and Broekens. He is also one of the leaders of this project. Just like Koen Hindriks, he has an interest in the development of the virtual humans.

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The Aim

The goal of our project is to create a virtual human that can interact with other artificial agents to successfully complete an iteration of the Tygron game we develop. The AI player will be able to take actions, make decisions and react to other players based on its environment and the other players' actions.

To simulate realistic behaviour for the virtual humans we will need to develop strategies upon which they can base their decisions and, since humans aren't solely logical and strategic, the agents should have an emotional component that influences their decisions. These emotions should of course be related to the events happening in the game. The strategic component of the agent will be implemented in GOAL and the emotional component will be implemented with use of GAMYGDALA.

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Key Elements

4.1. GAMYGDALA

A key element of our product will be the addition of artificial emotions rendered by the GAMYGDALA engine to the goal agents we develop. The emotions of our virtual player will make their decisions more similar to the choices a human might make. Emotion-based agents are vital to the success of the Tygron product because this method simulates human behavior better than a system based purely on logical decisions, as noted by Propescu et al.[4] "Many computer games would be more interesting and entertaining if the Non-Player Characters would express emotions and behave emotionally." This element of our design will ensure that players are provided with a realistic environment to develop their decisionmaking skills and realistically replace players who are not present. Also, GAMYGDALA is scalable, which means that it can be extended with more facets of emotional psychology even after the development of the project has been discontinued.

4.2. Tygron Interface

Another key element of our product is the interface. It translates commands from GOAL to actions in the Tygron game and provides the GOAL agents with information from the Tygron game in the form of percepts. This would not be possible without the development of an interface using the EIS and the Tygron server's JSON API. We will implement functions in this interface as needed to suit the functionality of the game and the agents being developed.

The Tygron Interface will automatically connect to a session on the Tygron server when provided with a session id or session name. It will also be able to create and kill session, if necessary.
The agents will be able to perform any action of their respective roles in the game, such as building, demolition, buying land, and transferring money to other players. They will not be required to perform lower level actions, such as location selection and confirmation of finished projects. They will not select locations to build on. Instead, they will only provide the cost and, if applicable, surface area of a building project. The placement of the building project will be calculated and performed by the Tygron interface by placing it on any available land. Buying land will be done in a similar way. The agents will provide the size of the land and the amount they're willing to pay per unit of land. The interface will determine from which owners to buy land and, if necessary, buy it from multiple owners. The location will be random and may therefore not be adjacent. Other players do not have to sell land to the agent, therefore it may not be possible to buy the amount of land specified by the agent. After the sales have been confirmed, the interface will inform the agents on how much land has been acquired.

The Tygron game requests confirmation after every completed building project, money transfer, and demolition project. These confirmation requests will not be sent to GOAL agents, but will be handled by the Tygron interface, so the agents are not required to handle low level information.

Aesthetic aspects will not be taken into account. One building project may be spread across multiple separate areas on the map and will therefore appear as multiple small buildings instead of one. During this project, the ability of the agents to fulfill their role is of a higher priority than building for aesthetics. The project time is very limited, therefore the final product will not have this feature. However, the interface can be expanded in the future to include better placement of building projects by agents.

The interface will translate low level information to high level information that GOAL agents can reason with. Agents will not receive the polygons that the Tygron API sends as a response, nor will they receive specific locations of their building projects, but will instead receive their available surface area and their budget. The calculations necessary to determine this will be done by the Tygron interface. They will also receive information about other players, such as their role, their budget and their available land.
The interface is not built specifically for the test game. The focus is on the key elements of the game and some elements might be skipped. This effectively means that it will be possible to run and use the connector on other maps / test games as well, but it might require extra functionality to be programmed to use all features of the game.

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Comparison with existing products

In this section we will describe the different competitors of the Tygron engine. There is no other serious game, as far as we have found, that uses virtual agents. In the table an overview of differences and similarities between the products we analyzed can be found. First we will describe the three different sections of competitors that we could distinguish that are active.

The B3 game[5, 6] was made for the government in Hamburg to allow for public input on the market place in the city district Billstedt. They wanted to know how the citizens envisioned the marketplace so that it would be a nice place. The B3 game allowed the citizens to design and send in their view of a nice marketplace and other citizens were able to vote on their favorite ideas. It was also meant as a way to learn about the current situation and issues in the district. The game was implemented with Adobe Flash. Other areas could also be included in the game.
Several researchers have tried/researched public participation in urban planning. Wu et al. (2010) have made an experimental 3D virtual visualization of the Chinese city Shenzhen using "GeoGlobe, a prototype platform developed by the State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS), Wuhan University". Users can use tools to alter the city.

There are also some board games that are used for urban planning. The company Play the City makes board games specific for a certain area/city to help different stakeholders involved in urban planning to overcome challenges. The organization Cordaid also has developed two games for urban planning also meant to be played by different stakeholders at the same time and is meant to stimulate development in poor areas. Whereas the Play the City games are developed to help with city planning in a specific area/city the games by Cordaid are used to make stakeholders "aware of the power of collaboration in slum development". While the B3 game and the experimental game from Wu et al. (2010) are meant as experiments in public participation in urban planning, the game by Tygron is meant as a commercial tool to help different parties negotiate in urban planning. Similar to the games by Play the City, Tygron makes games specific to the cities/areas that are being worked on, whereas the games by Cordaid are meant to stimulate development in poor areas. Advantages of Tygron over the Play the City games include that it can be played online and is easier to adapt and to start over.

Now we will expand on the unique selling points of our product. First of all, of the products mentioned Tygron is the only commercial company with city planning software. Working with software instead of hardware means it is a lot easier and faster to make changes to a project and to create new projects. Additionally, since it can be played online you can also play the game without all being at the same location. Since Tygron is commercial it offers services for making games tailored specifically to a certain area/ problem whereas the B3 game and the product by Wu et al. (2010)[7] are less flexible. Tygron also is the only one that offers a climate game to integrate city planning with adapting to climate change.

Finally, the addition of virtual humans offers multiple advantages. One of the advantages is that it is possible to replace some of the players with virtual humans, making it possible to play a game and still have all sides be represented without a need for all stakeholders of the project being simulated to be present/willing to play. Another advantage of virtual humans is the possibility to simulate games. This way a lot of simulations can be ran to present players with multiple possible solutions.

Product	Type	Differences	Similarities
Tygron (with virtual humans)	Software	Has a climate game to integrate city planning with adapting to climate change. Useful as educational too. Easy to create specific projects. With virtual humans games can be played without having all the stakeholders present. Instead of playing games, simulations can be done to present stakeholders with multiple solutions.	Commercial similar to Cordaid and Play the City. Games are made for specific cities/areas and for stakeholders in city planning similar to Play the City.
B3	Software	Informational. Public voting system. 3D but less accurate/detailed than Gyron and Wu et al. (2010).	Similar to Wu et al. (2010) in experimenting with public participation and user created content.
Wu et al. (2010)	Software	Users can comment on urban planning projects and user generated content. Detailed information, e.g. building properties, measurement and sunlight tools.	3D visualization similar to Tygron. Experiment in public participation similar to B3 game.
Play the City[8]	Board Game	Games can be made for purposes other than city planning, e.g. violence prevention, issues related to refugee camps.	Games are made for specific cities/areas and for stakeholders in city planning similar to Tygron. Commercial similar to Cordaid and Tygron.
Cordaid[9]	Board Game	Meant to improve quality of life in slums. Made for public and private stakeholders in city planning. Game is not made for a specific city/area.	Commercial similar to Play the City and Tygron.

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Further Research into virtual humans

Being students at the CS faculty of the TU Delft, we already have some experience developing virtual agents for the MAS project in the first year of our education, where we developed teams of agents that competed in team format in Unreal Tournament 2004. In that project we used a bridge from GOAL to the Unreal Engine developed by Hindriks et al.[10] using the EIS standard, and we developed the agents in Goal, which means we all have some experience working with artificial goal oriented agents.

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Time- and Budgetframe

This project is divided evenly between 4 groups, with 5 members each. Each group will implement a separate part of the product. The target time frame for developing our virtual human starts on the 28th of April and will continue on until the 24th of June, which gives our teams two months to complete the project. The estimated time needed for this project is 280 hours per person. Per project group, the estimated time needed will be 1400 hours. The budget for the whole project, expressed in man hours, is 5600 hours. This includes development time, the time spent attending informational lectures, homework from said lectures, and the plenary session in which the project is evaluated.

The draft and final version of the product planning should be delivered on the 7th and the 15th of May, respectively. The draft and final version of the emergent architecture design should be delivered on the 30th of April and the 19th of June, respectively. The draft and final version of the software should be delivered on the 26th of May and the 19th of June, respectively. The draft and final version of the final report should be delivered on the 18th of June and the 24th of June, respectively. Because this is an educational project, the budget for this project is €0.

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Future upgrades

The future for a virtual human could be very exciting. For this project, a simple virtual human is created for interaction with the Tygron Engine 2.0. This product can evolve with time. The product can improve on many parts, but due to lack of time, budget and human resources, it had to be an basic version of our product. A few improvements we would really like to see, but cannot implement now, will be shown here.

For start, a virtual human should be able to communicate with a human player. The virtual human should explain the choices it makes and be able to answer questions about this choices. Why did a virtual human build an office, while it is not really usefull for him?

In the further future, a virtual human can discuss certain choices with the human player, being persuaded into building or buying land. This should make it nearly impossible to notice any difference with a human player and a virtual human player. The only real difference is, that talking with your fellow players now does not go verbally but through the game.

An extra feature is to have the possibility to give each virtual human an own unique personality and gender. For example, a person that likes animals would have a small preference for an animal shelter than a sport center. An other thing is that men and woman have a natural different way of handling conflicts. This changes the dynamics of conflict resolving for the virtual humans.

Also, the possibilities for human emotions could be explored a lot more. Humans have a lot of emotions, a lot more than GAMYGDALA has at this moment. More emotions would give a huge new perspective on the way the virtual humans react. For example, if a human is in love, some less smart actions are made. This would change the entire game, which makes the virtual humans a lot more “human”.

A way to make sure that the city plan you create during the game is useful, the product should have virtual humans behind civilians in the map. These humans should be pleased or displeased with certain decisions you make, based from real data. This way you can get a “live” response from virtual humans to know how actions affect a particular area. For example, if you build a railway in a housing area, a lot of civilians would dislike this, while other civilians, not living in that area, would like the extra transportation. Using these civilians will show exactly who would like and dislike a particular action.

9

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