University of Technology Delft

Virtual Humans for Serious Games

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Tygron Strategy Research

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Abstract

This is a research report about strategies for the Tygron Engine. The research is part of a virtual human context project which will implement a virtual human that connects with the Tygron engine and should be able to replace a human player. By using the Thinking Aloud method, as described on page 4, an analyses is made from real humans about their interpretation of the Tygron engine and the game aspects. Furthermore, their is a strategy plan for each stakeholder implemented in the game, page 4 until page 6.

Contents

Introduction

Virtual humans are used a lot in the daily world, for example in games. Such virtual human perceive events and perform actions based on these events. This kind of virtual human would be a simple virtual human that react on incoming messages from the environment. In some cases this is a sufficient solution for a simple system, but in our case it really needs to replace a real human that strategizes. A real human always thinks ahead and considers previous actions. Also, emotions can affect the choices of a human. Humans are complex and react different on each game. So how does a human think during a Tygron game? Which strategy does a human use when playing a Tygron game?

Research

The best way to determine a realistic and fitting strategy, is to research the steps a real human player takes during a game. The game asks the human to constantly make choices. There are a lot of factors that a person takes into account when making choices. For example, humans have emotions which can cause the player to take unexpected actions. If a human is positively satisfied, the human will take more risks than, in comparison, when the human is scared. But moreover, even humans use simple predictable strategies when playing a simple game.

Therefore we decided to have two game sessions, where we observe what real humans do in certain situations. Both sessions will use the thinking aloud method. We will go into details about the thinking aloud method in the next chapter.

The first game session will be played with our developer group members on the final map we created. We have more knowledge about our map than most, so we will consider other elements than people that still need to figure out how to do actions. Of course, we have more knowledge about the game than people that actually play the game, so we have a second session with non-developers.

The second session will be played by people who have never played the game before. This will also be done on the same testmap. These players havent seen how to play this game the right way, so they might create a new strategy. The idea behind this is to find the similarities and differences of

the these two sessions and create, by using these results, the best possible strategies for the virtual humans.

After the research we constructed a decision tree that explains the steps people take during the game.

Method Thinking Aloud

There are different methods for figuring out how a person strategizes. One of the methods is Thinking aloud method [1]. This method focuses on the thoughts and speech of a user when interacting with the system. When using this method, the users speak out loud what they think while performing actions. Without any questions, users just tell exactly what they are thinking. This is the ideal situation for determining what strategies real humans have. By really keeping track of the steps a human takes while playing, a strategy can be formed.

This method, above other methods, fits the most perfect with our needs. Since forming a strategy without research would be unrealistic, using this method should give an idea how users experiences the game and how they create a strategy for it. g A problem with humans is that humans are not always able to articulate their thoughts. A way to make it possible for each individual to find an own method to explain his or her thought is by by explaining the Thinking Aloud method and by doing this a couple of times. By doing so, a human will have the opportunity to find sensible words to explain his or her way of thinking.

Strategies

Each stakeholder need its own strategy. In this research, three stakeholders will be analyzed. For the full list of events during the games, please look at the appendices. Since both game sessions were played with following the same strategy, except for one major difference, we did not include the results of the non-developper game. The difference will be explained in the general section.

General

During the game sessions by us and the non-developpers, we saw one major difference. Playing the game several times gave us an idea how much, and how fast, you can make money. We spend most of our money on land, leaving verry little budget for when something go's wrong (e.g. a permit is not accepted). In the game that the non-developpers played, we observed that the players did not have the knowledge we have. Therefor they spend a lot less money at once. For example, when buying land we spend 90% of our budget, yet the non-developpers spend 20-30% of there budget. This is one thing we will implement in our strategy, buying small parts of land, not building it full imediatly and so on. This should improve the virtual humans, since it would be difficult to run out of money, and most of all, it is a lot more realistic when using this strategy.

Company

The companys targets are building offices and parking areas. To achieve progression in both targets, the company needs to buy land. The basic strategy is fairly simple: the company buys land and then builds offices on that land. When the target for building offices is reached, the company focuses on parking areas. For this it uses the same strategy.

Now, of course, it is not always this easy. Available space, available budget and the other stakeholders are influential factors in this strategy. Available space is solved by buying land, on the basis that there is enough land on the map to buy. Buying land requires money, so enough budget is needed. Luckily it turned out that budget is not something to worry about.

The other stakeholders are more of a problem in making up a strategy since they are highly unpredictable. There are two other stakeholders involved in the game. One is the housing corporation, which has a very little influence on the strategy. The only thing that the housing corporation and the company have in common is land. Like we said before, we assume there is enough land for both stakeholders to complete their targets.

The municipality is the other stakeholder and this is where emotions also take part in the strategy. The municipality is actually running the whole show. In our game it hasnt the rights to construct buildings but only accept or reject permits. However thanks to the right of resolving permits, the municipality can decide how the map is going to be distributed among the

stakeholders. The municipality has the indicator for parking in common. This is beneficial for negotiating which can be needed when the municipality does not accept the companys permit right away. To be more clear, if this happens the company can invest in building parking areas instead of offices. In this case it is still advantageous for its own targets. After the parking areas are built, the municipality is more likely to accept the next permit of the company.

The actions that were taken by the company follow a pattern. After carefully studying the results of the thinking aloud method, we found a tree that shows different moves the company can make, indicated by different paths down the tree. Each node is an action for the strategy. See figure 1 for this tree, which is a simplified version of our strategy. It does not include emotions yet.

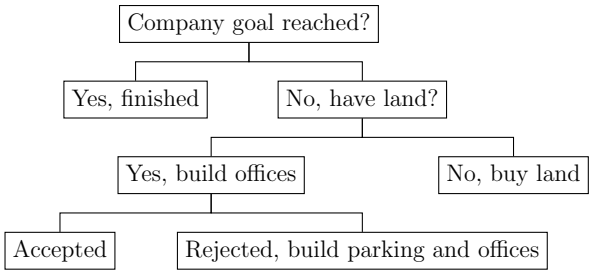

Figure 1, the more detailed version can be found in the decision tree section.

In this tree, the pattern is described. For example, when the player has no land, he or she buys new land. There is no need to buy new land when the player is finished or still has empty land. When the player has land, he or she should build offices. If the municipality does not accept offices, he or she wants parking lots first, the agent will know the buildings have been declined. Therefor the player builds offices and parking lots.

To conclude the strategy for the company, it buys land and builds offices on that land. When the target for building offices is reached, the company builds parking areas. If there occurs a conflict with the municipality when building offices, the company switches to combining buildings and parking areas.

Housing Corporation

Building houses and keeping a certain budget are the two targets of the housing corporation. A simple way to achieve this would be to buy land and

fill it with houses a high as possible. Once the houses are built the housing corporation earns money from the houses, so the housing corporation also achieve our budget target.

Unfortunately the housing corporation is not the only one on the map and needs permits from the municipality to keep the houses it has build. Once the housing corporation tries to fill its land with high buildings, the permit is denied. It turns out high buildings go against the municipalities building plan.

By building a lot of houses, the green factor and parking factor go down, which are the municipalities indicators. So the housing corporation must build either parking lots or greenhouses/parks alongside the houses to make the deal more appealing.

Just like the company's behaviour, the actions taken by the player of the housing stakeholder follow a pattern. So we found a tree which shows all the actions the housing corporation normally takes as well. Just as with the company, this strategy does not include emotions, but gives a simple and clear image of our strategy.

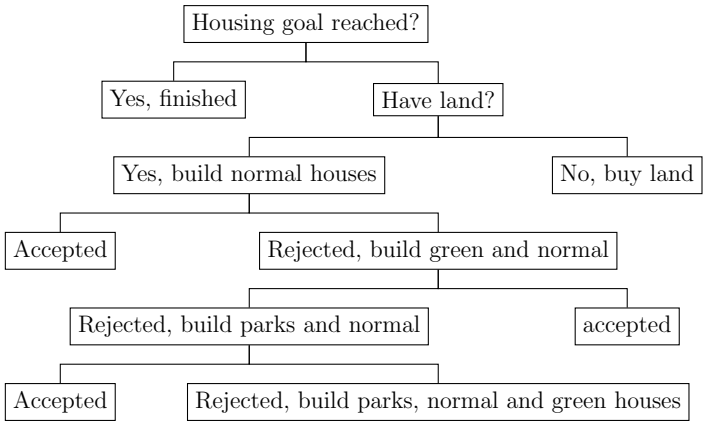

Figure 2: the more detailed version can be found in the decision tree section.

In figure 2, we constructed our final strategy. First the housing corporation buys land for half its budget, this way he will have enough money left to build houses, but also enough land to make progress. Then he fills his land with affordable houses and tries to get a permit. If this permit is declined he tries to fill half the land with affordable houses and half with green houses, and tries to get a permit again. This way he still has the same amount of houses, but just a bit more expensive. If this is declined as well, he fills 80%

of the land with affordable houses and fills the rest with parks. If this is rejected as well, it tries 50% of the land with affordable houses and fill the rest with parks. The final solution, if this plan is rejected as well, is to fill 50% with green houses and the rest with parks.

Municipality

The municipality is a special stakeholder. It cannot build any houses or parks, but it has full power over the land. Municipality has the capability to accept or decline permits of other stakeholders and to sell its land. It also has two main targets, green and parking.

Municipality wants a number of square meter green per house. The more houses that the housing corporation builds, the more this target declines. The only way to get green is to enforce the housing corporation to build parks in stead of houses. This is done by declining housing permits. By doing so, the housing corporation will understand that the municipality does not want houses and will find a way to satisfy him.

The other target, the parking, has the same idea is that of the green. The only difference is that the company is the only one that can build parking. So the municipality will decline offices, so that the company will build more parking.

Complications

One of the main problems that was encountered, is communication. When the game is played, it is almost a necessity to communicate with your team to reach your goals. Conflict appear, and to fix these conflicts, negotiation is needed by the users. Implementing negotiation techniques as described in M. Filzmoser paper [2] is too complex for the time we have been given. By making the possibilities of the game as simple as possible, the virtual humans will have only a few choices to make.

Since our map is a simplified version of the game, no real negotiation is needed. For example, if the housing corporation builds houses, but the municipality declines this, the housing corporation will know it has to provide more green. By using simple step driven thinking, the virtual human will always be possible to do something.

Decision trees

Housing Corporation

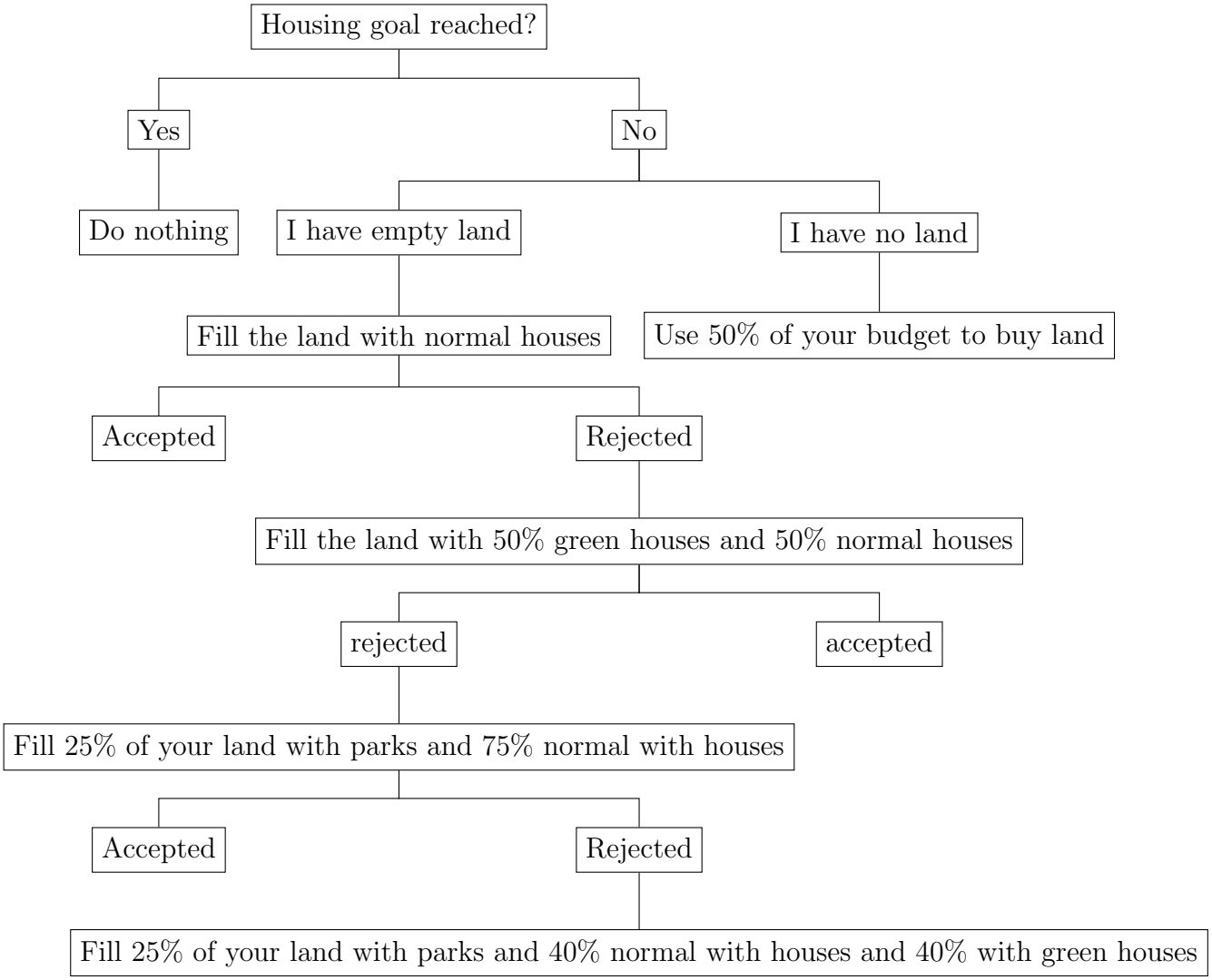

Figure 3: The detailed version of the tree for the housing corporation.

The figure shows what steps the housing corporation takes. Each leaf of this tree shows an action. If this action gets rejected, it will try again with different percentages, in favor of the municipality. For the housing corporation, this means building more green. For example, if the buy land option get's rejected, it buys less land.

Company

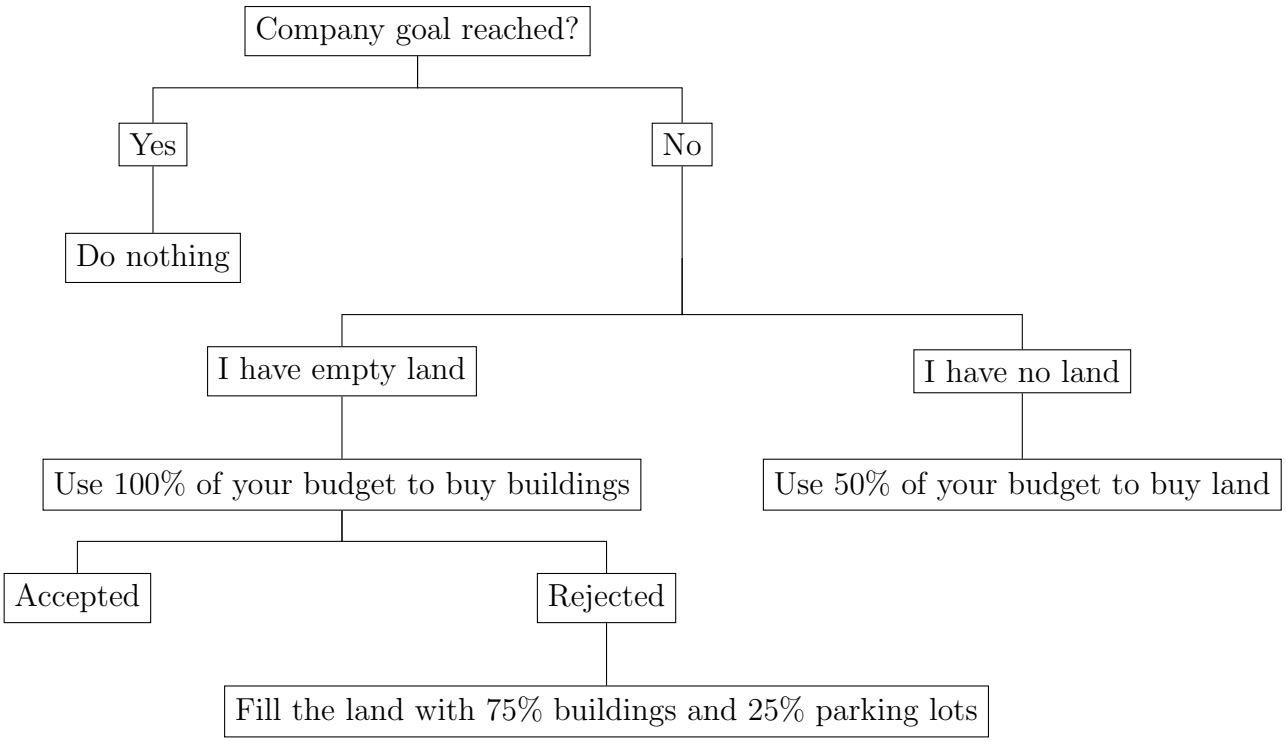

Figure 4: The detailed version of the tree for the company.

The figure shows what steps the company takes. Each leaf of this tree shows an action. If this action gets rejected, it will try again with different percentages, in favor of the municipality. For the copmany this means it has to build more parking lots. For example, if building 75% offices and 25% parking lots gets rejected, it will try with 60% offices and 40% parking lots

References

[1] Someren, M., Barnard, Y. (1994). The think aloud method: A practical guide to modelling cognitive processes. London: Academic Press.

[2] Filzmoser, M. (n.d.). Automated Negotiation. Simulation of Automated Negotiation, 45-77.

Appendix A: Company game events.

Observation	Conclusion	Reason
I do not own land	I buy land (about 90% of budget).	To earn money, I need to build offices. Therefore i need the land. I will earn the money back, so I spend most of it.
My current buildings indicator is 0%. There are a few parking lots.	I build the land full with offices and request a permit.	Since there are parking lots, the parking indicator is high now. Therefore offices have high priority.
The muniplicity gave the permit.	I make a lot of profit. The target for building raised to 30%	
I made profit	I become happy.	Budget is one of the indicators, so making money makes me happy.
I have budget, do not own land and have not reached my indicators.	I buy new land (about 33% of budget).	Since the municipality wants more parking spaces, i will use this land to build them.
I own land and need parking lots.	I build new parking lots.	The municipality wants me to build these, i need to keep them satisfied, else i do not get permits for the offices.
The indicator for parking spots raises to 96%.	This makes me happy.	I almost reach the first indicator. I keep in mind that if more houses appear, we will need more parking lots.

I do not own land anymore, and have a lot of money. My build target is not 100% yet.	I buy land (90% of budget.)	I need to reach 100% for my last indicator.
I have land.	I build more offices, but not on the full land.	I reach my indicator for building, but i have some land left to build parking lots.
The municipality accepts my permits.	I am really happy.	I reached both my indicators.
My parking indicator decreased, since new houses are build by the housing stakeholder.	I build new parking lots.	I do this to reach the 100% for the parking indicator.
I repeat the last step while the housing corporation builds new houses.		

Appendix B: Housing corporation game events.

Observation	Conclusion	Reason
I don't have any money, land and my housing progress isn't full yet	I buy land for half of my budget	I'll have enough money left to buy houses
I made an offer for the land with the municipality and they accepted	I feel good	Now I have land to build on
All the houses surrounding mine have at most 2 floors	I will keep my buildings low as well	This increases the chance of the municipality approving of my buildings
I have money and land	On half of the land I'm going to build houses with 2 floors	My housing progress goes up
I've built my houses, but I don't have a permit for them yet	I request a permit with the municipality	This way my houses can stay
The municipality accepted my permit	I am happy	My housing progress can stay up
I have money and half of my land is still free and my housing progress is not full yet	I fill the remaining land with 3 story houses and request a permit	I feel motivated by my previous success
My permit was declined	I feel sad	My houses can't stay
I ask the municipality for the reason	I will build more green	The municipality wants parking lots and green, but I can't build parking lots
I have money and half my land is empty and my housing progress is not full yet, but my previous plan was rejected	I fill the land with 2 story green houses	These houses are more expensive, but I didn't get a permit for normal houses

I have money, but all my land is filled and my housing progress is not full yet	I buy new land	So I can build more houses and fill my housing progress
I received the land	I feel happy	More land means I can build more houses
I have money, land and I need to fill my housing progress	I fill half the land with 3 story normal houses and the other half with 3 story green houses	My previous plan of building only normal 3 story houses was rejected
Municipality accepted my permit	I feel good	I am at a quarter of my overall progress
I have a lot of money and my land is filled	I buy land and offer a bit more for it	I really want the land so I can get closer to my goal
I have money and land that needs to be filled	I fill my entire land with 3 story normal houses	This get me closer to my goal fast
Municipality rejected my permit	I feel horrible	Those houses brought me quite close to my goal
My land is empty and I have money	I fill about half of the land with normal 3 story houses and fill the rest with parks	This gives me quite a few houses and the municipality has its green
My land is full again and I have enough money	I buy more land and offer more for it	I have money to spent because of my previous success
I have land that is empty and a lot of money	I fill most of the ground with 2 story green houses and fill the rest with parks	By adding parks there is a bigger chance my deal will be accepted
I have money, but no land to build houses on	I buy more land	I buy enough to finish my overall progress
I have enough land to reach my goal	I fill the land with 3 story normal houses	This is enough to reach my goal
The municipality rejected my permit	I decide on building 3 story green houses instead of normal	The municipality wanted more green

My permit is accepted and my goal is reached	I do nothing and feel really good	I shouldn't spend any more money because I don't need more houses

Appendix C: Municipality game events.

Tygron
Karim – municipality.

Observation	Conclusion	Reason
Housing wants to buy 1600 square meters for 640.000	I accept the offer.	I expect the housing company to build houses on them, and i want the city to grow.
Company wants to buy 1200 square meters of land for 480.000	I accept the offer.	I expect the company to build offices and parking lots, and i want the city to grow.
Housing wants to build affordable houses, -14% parking.	I accept the offer.	I want the city to grow.
Company wants to build company houses (offices). -16% parking.	I accept the offer.	I want the city to grow.
My parking indicator is low.	I will only accept offers when I get more parking places.	I want to reach my target.
Company wants to buy 3000 square meter of land for 1.200.000	I accept the offer.	I want the company to build parking lots, so i accept the offer.
Company builds parking lots, up to 96% of my target.	This makes me happy.	I need the parking lots.
Housing wants to build green houses, parking goes back to 90%	I accept the offer.	I still want the city to grow, and green houses are good for the green indicator.
Housing wants to buy 2400 square meter land for 960.000	I accept the offer.	I expect more houses and want more green, so i accept.

Company buys 4800 square meters land for 1.920.000	I accept the offer.	I expect more houses, so i want the company to build more parking lots too.
Housing askes permit for affordable houses.	I accept the offer.	The green indicator gets lower, but i asked to build more green.
Company buys land to build parking lots.	I accept the offer.	The company will get the parking target back to 100%.
Housing buys land and builds affordable houses.	I decline the offer.	The green factor gets to low if i accept.
Housing tries again with only green houses and parks.	I accept the offer.	Both my parking and green factor are almost 100% now, and the city has grown a lot.