VIRTUAL HUMANS
FOR SERIOUS GAMING
FINAL REPORT

Jannelie de Vries
Harmen Kroon
Tom Brunner
Nando Kartoredjo

TUDelft

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1   Introduction

This project is build around the Tygron Engine; an urban planning 3D software product. It requires different stakeholders to work together in real life locations. This allows all parties to simulate how certain decisions might influence everyone participating. All planning is done in real time, which makes the simulation more real, but creates problems requiring every stakeholder to be physically present during the simulation. This is commonly done through Charretes(Todd & Lindsey, 2013). To combat this problem we are tasked with designing and creating a virtual human, which simulates a real stakeholder by the use of artificial intelligence programming. This virtual human is designed around a scenario created at the beginning of the project, but should be capable of acting in a multitude of scenarios in order to be of use to any actual simulation involving users of the Tygron Engine.

In this report we will go over a couple of aspects of the project, process and product. First we will give an overview of the developed and implemented software product. Then a reflection is discussed on the product and process. This is done from a software engineering perspective. Thirdly, the developed functionalities are discussed. The following chapter contains a detailed explanation about our implementation of interaction design techniques. In the sixth section an evaluation of all the functional modules and the product in its entirety, including a failure analysis. Lastly an outlook on the project is given.

2 Overview

In this section we will give an overview of the developed and implemented software product. The developed product consists of a combination of software features. The two features are the Tygron Environment Connector and the GOAL Services Virtual Human. The architecture of the product consists of the GSVH connecting to Tygron Engine through our TEC. The virtual human can retrieve information about the game and send actions to the game through the connector. The complete architecture of the product is discussed in our Architecture Design Report(de Vries, Kroon, Brunner, & Kartoredjo, 2016). Over the course of the project we had to build on a pre-existing connector wich severely lacked any useful features for implementing a GOAL driven virtual human. As mentioned before, the virtual human is built using the GOAL Agent Programming Language(Hindriks, 2016). This language is a prolog based artificial intellegence language in which agents derive their choice of action from beliefs, knowledge and goals.

2.1 Tygron Environment Connector

On top of the provided connector a lot of improvements have been made over the course of the project. All improvements over the original connector are put in a package. In this package contributions of all teams related to this context are put together. This package extends the connector with more percepts about the game, which a GOAL agent can use to gather information. The extension also contains custom actions, that allow our virtual human to more extensively manipulate the game.

2.2 GOAL Service Virtual Human

Our virtual human fulfills the services role in the scenario. This means that our virtual human can build convenience stores, terraces and sports centers in de TU Delft campus area. The game provides the virtual human with indicators related to the three categories our services need to cover. The virtual human will make cognitive decisions based on these indicators and or experiences with other stakeholders present in the game, wether these other stakeholders are human or virtual humans. The virtual human is designed in such a way that it will behave like an actual human would in this game; by both reacting on other stakeholders and building believable buildings in the game.

3 Reflection

In this section we will reflect on the product and the process from a software engineering perspective. We will give information about how to improve and which lessons we have learned during this project.

3.1 Product

The final product we have made, is not the product we had in mind at the start of this project. We expected to have more interaction with the bot and to have a much better strategy. At the start of this project we expected that we had to implement a bot for the Tygron game and that the connector had all the information we needed. That we had to write a strategy for our bot so it was able to play in the Tygron game. Unfortunately we were wrong. We also had to implement the connector. We had to make sure all the information we needed for the bot, was implemented in the connector. So instead of using the percept, we had to write the percepts. This caused a big change in our plan. Because instead of focusing on a strategy, we needed to focus on implementing code to get percepts before even thinking about a strategy. So our final product is now a basic bot, who is able to do basic steps, like building and buying. But a very nice strategy or interaction with other bots, is not really there. The improvement for our bot is to have this nice strategy. We weren't able to have this, because we didn't have the information implemented in the connector. Now we have. So if we had another ten weeks for this project we should be able to build the strategy we had in mind. We should be able to think of a strategy and implement this using our code from the connector, because then we don't have to implement anything new in the connector, .

3.2 Process

Our process was quit organized. We used SCRUM to plan our sprints and almost every day we worked together. We discussed when we needed to approve pull requests and we helped each other out when there were issues with computers. Because sometimes, some computers had problems running Tygron. Then we would run the code on another computer. We had one team member, that was always late and sometimes didn't show up at all. He also did not do much for the product. We learned that communicating with the TA's can help a lot. Because we communicated each time he didn't show up and reported the exact hours everybody spend at something, instead of just filling in so everybody had enough time, we were able to show that he was a problem in the team. But he decided to stop and we became a team of 4 members. We kept communicating with each other when somebody was late or didn't show up, so we knew what was going on. Also we kept filling in the right hours even if this caused somebody to have less than 28 hours. IF you had less, then you had to make this extra hours the next week. An improvement of our process should be, to meet everyday and make sure the expected hours are spent. In this case we would be able to finish more tasks during a sprint.

4   Description

5   Interaction Design

6   Evaluation

7 Outlook

Next time we work on this project, we will focus on implementing the strategy. The complete strategy we want to have is described in appendix A. All this is not yet implemented in our bot, because we didn't have enough time to implement the connector and the bot. So next time, we would start implementing this. We would like to have more interaction with the other stakeholders. Also we would like the connector to have more percepts based on our strategy. So we start with implementing the strategy and when we think we need a more specific percept, we would implement this is the connector. Instead of implementing things in the connector and then looking at the strategy. Because we have the basic implementation this is now possible.

References

de Vries, J., Kroon, H., Brunner, T., & Kartoredjo, N. (2016, June). *Virtual humans for serious gaming: Architecture design.*

Hindriks, K. (2016, Jun). *Goal 2.0.* Retrieved from `http://ii.tudelft.nl/trac/goal/wiki/wikistart`

Todd, J. A., & Lindsey, G. (2013, April 09). *Planning and conducting integrated design (id) charrettes.* Retrieved from `https://www.wbdg.org/resources/charrettes.php` ([Online; accessed 4-May-2016])

8 Appendix A

In this section we describe what strategy we wanted to have for our bot. Also we will describe what strategy we really have.

8.1 What we wanted as a strategy

- behaviour concerning buildings:

    - A building should be able to change the indicators for services.
    - A building should be able to change indicators for other stakeholders.
        * This could be an advantage or an disadvantage for other stakeholders.
        * For example increase the green indicator or nuisance.

- behaviour concerning building:

    - A building could be built if this has the highest priority looking at the indicators.
    - A building could be built if this has positive results for all indicators.
    - A building should be built with a realistic shape.
    - A building should be built within the given size or area.
    - A building should be built based on other buildings and locations.
        * For example next to roads or close to other buildings you own.

- behaviour concerning demolishing:

    - A building could be demolished only when it has a minimum effect for that indicator.
    - A building could be demolished if it isn't any of the buildings services want to have, but services does own this building.
    - A building could be demolished if this is cheaper to use this land than buying new land.

- behaviour concerning selling:

    - A building should be sold when it has a minimum effect on that indicator and the money we get is enough to cover building the exact same building.
    - Land should be only be sold if we have enough land and we get enough money for this land.

* There is enough land if all indicators have a 100% score or when this can be reached.

- behaviour concerning buying:

  - Land should be bought in realistic shapes.
  - Land should be bought from other stakeholders if there is no land to build on and the indicators don't have a 100% score yet.
  - Land should be bought if there is no land to build on and if the price for buying is better then demolishing or if demolishing is not an option.
  - Land should be bought if it is in a zone which is useful looking at the indicators.
  - Land should be bought when it doesn't have any buildings on it.
    * If this is not the case, we need to buy land that has building on it.
  - Land should be bought if other stakeholders are offering this land.
  - Land should be bought only when it is for an acceptable price.

- behaviour concerning interaction with other stakeholders:

  - The stakeholders should be able to stop buying and selling of buildings or land if this has negative effects on our indicators.
  - The stakeholder should be able to send messages to each other.
  - Municipality should be able to accept or reject building permits from services.
    * A new building permit should be reviewed by municipality when old building permits are rejected.
  - Services should be able to send a building permit to municipality when a building is build.
    * Services should be able to send another building permit is an old permit gets rejected by municipality.
  - Services should be able to offer land to other stakeholders.
  - Services should be able to negotiate and compete with other stakeholders about the price for selling and buying land.
  - Services should be able to negotiate and compete by giving secondary gifts.
    * For example increase the green indicator or give money to other stakeholders.
  - Services should be able to get more respect from other stakeholders by giving gifts, so we are able to do more when negotiating with these stakeholders.

8.2 What we have as a strategy