Updating Story CreatAR for General Use

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I. Introduction

In the GEM Lab at Dalhousie University, where Story CreatAR was developed, we continue to enhance and prepare the software to be released for authors to build interactive stories in Augmented Reality. The application was functional since taking on the project this summer and we are enhancing the product to have it ready for use outside of the GEM Lab. What are the enhancements being added to this product to make it ready for use? In short, we are making it more open ended and a more usable product. When the product was first seen in May 2022, it was only ready to be used in two buildings; our very own Goldberg Building, and the Mona Campbell Building at Dalhousie University. We would like for the user to be able to upload a floor plan of the area they are using and be able to build their story without having to make changes to the codebase. We must also make the application more understandable. An example of the application not being understandable to the end user is that we use technical terms such as "openness", which is a synonym in this instance for "isovist area", which may not be understandable to a non technical user. We will make these more user-friendly by adding tooltips with comprehensive definitions.

II. Prior Work

"Authors" is synonymous with users when talking about the use of Story CreateAR [1]. This is because Story CreateAR is a tool that helps authors of stories place elements in a physical space to help tell their interactive story. These stories are interactive because users witness them through Augmented/Virtual Reality headsets which power Story CreateAR. Some of the headsets used in the GEM Lab are the Microsoft HoloLens 2 and the Magic Leap One [1]. The reason that handheld devices are not used to tell these stories is because the witness of the story would have to be able to predict and point the camera wherever the next avatar is coming from [1]. Whereas, with devices such as the Leap Pad One with extended peripheral vision can allow the user to be surprised by an avatar entering the room or their field of vision at the corner of their eye. One of the pains that Story CreateAR is answering is when the location is unknown and makes it difficult to find the optimal location for placing story elements in this unknown location. Story CreateAR answers this by integrating spatial analysis techniques (powered by Space Syntax) to allow authors to define placement, traversal, formation rules and group elements so that they can be placed together. Tools used for the placement of objects and analysis of the location would include Depth Map X and Space Syntax [1]. These functionalities and tools help the accuracy of the story telling and have it been presented in the way the author would prefer.

III. Enhancements

A. Increasing Comprehensibility for Authors

Authors of these interactive stories are not up to the technical level of a developer that can manipulate the application. One requirement was to be able to make the creation of stories more understandable so that the author knows how it will be executed. This can be demonstrated by displaying definitions of technical terms that have to do with attributes that determine how an avatar will function. Another issue besides user comprehension upon creation is predictability. By predictability we mean that the author will be able to predict how their story will be executed. In past case studies, a common issue arose where the author thought the story would be executed in a very specific way, however that is not the case in Story CreatAR. In our tool, the creation of the story can vary upon execution. For example, if you selected a medium sized room in the Mona Campbell building for the story to take place, it could be any one medium sized room in the floor plan. Which room it is, can change each time. Authors must understand that it is a tool that has different results and the interactive story will not always be predictable in terms of how it is executed.

B. Making The Program More Open Ended

At the moment, Story CreatAR is able to be configured for two floor plans. This includes Dalhousie's Mona Campbell and Goldberg Buildings. Upon release, it will not be uncommon for Authors to be located outside of Dalhousie and want to configure their interactive story for other floor plans, such as parks and other buildings. We will be allowing Story CreatAR to accommodate any floor plan. The way we analyze floor plans is by using a DepthMapX [1]. depthmapX is an open source spatial analysis tool developed at the Space Syntax Laboratory, University College London [1]. Currently, DepthMapX can take in any floor plan. However, Story CreatAR cannot. This is what we are adding in for functionality to allow for any floor plan to be used in Story CreatAR.

Ideally, the user will be able to upload the floor plan to DepthMapX then from there import it into Story CreatAR with the guidance of a document that outlines what dependencies to fulfill. This is the easiest way and does not assume any technical knowledge or coding knowledge of the author. We want this tool to be easy to use and ready to deploy with any story configuration, at any place.

C. Adding Placement Conditions

When using Story CreatAR an author can select a placement condition, such as "easy to find", to specify where they would like a given object to be placed in a floor plan. To do this, data is collected from a spatial analysis tool called depthmapX to find a location that matches the description. Story CreatAR currently uses the space syntax properties of Openness, Visual Integration, and Visual Complexity to find an optimal location for an object, however there are additional analyses that depthmapX is capable of running that have not been used by Story CreatAR. By integrating more space syntax properties, authors will be able to place objects in different kinds of locations along with providing more accurate placements overall.

To better understand how people move through a space, depthmapX is able to release 1000 human-like "agents" into a floor plan and track where there are areas of high and low traffic. This data can be used by the placement algorithm to find a busy or quiet area, or it can be used to support a condition like "Hard to Find" by showing what areas have low traffic, and are thus less likely to be explored by the player.

Previous work on Story CreatAR has shown that authors can be confused by the final placement of objects as they do not always align with an area they had envisioned. Adding the attribute of traffic will reduce this confusion for authors by finding accurate placement locations more often.

D. Room Selection

Previous versions of story CreatAR have classified rooms as being "Small", "Medium", or "Large" based on if they are in the top, middle, or lowest third of an ordered list containing all the room sizes. While this approach may work in some floor plans, there are cases where rooms can be classified in ways that the user would not expect.A new approach that will be implemented into Story CreatAR will use the size of the smallest and largest rooms to more accurately and dynamically classify room sizes. Consider the size of the smallest room is S and the largest is L, all the rooms having a size between S and S+(L-S)/3 are small rooms. Rooms between S+(L-S)/3 and L-(L-S)/3 are medium sized rooms and from L-(L-S)/3 to L are large rooms.

To further subdivide the rooms in ways that the user might find useful, we will also investigate the benefits of allowing the user to select the "Largest" or "Smallest" room. This change might be beneficial for the user as previous work on the software has shown that users struggle with how unpredictable Story CreatAR can be [1]. By allowing the user to make this concrete selection, they may be given a sense of control in regard to room selection and reduce feelings of inconsistency.

Future Work

There is further implementation and improvement to be done within the Story CreatAR application. We have a few major changes that are out of the scope for our timeline with the project and will recommend it to the next contributors. The first recommended implementation is traversal events. At the moment, agents are in the scene as static characters, however they do not show movement. We want this to be implemented prior to release so that the stories that authors create are more interactive and the scenes come to life.

Story CreatAR currently only uses space syntax data to place objects in a floor plan based on properties the author has specified. This application of spatial analysis data has proven to easily and efficiently place static objects in Story CreatAR, but this data can also be used in other ways. Games often have background characters that move through spaces in order to add depth and complexity to a story, or to enhance the story line; however making these characters move in a human-like fashion can be challenging and computationally complex [2]. For games in Augmented Reality, an author may want avatars to move through a space differently from each other, such as taking a sneaky or central path. In order to integrate this functionality into Story CreatAR, additional space syntax data can be used in order to find an applicable path for the avatar.

If an avatar is to move through a space in a "sneaky" way, then an author would expect that they would move through non-central areas in the floor plan. Isovist Drift Magnitude is a space syntax property that is produced by depthmapX that can be used to find central areas based off of fields of view, called isovists. After an author has selected a start and end point for an avatar, this data can be used to find a path between the points using the smallest possible Isovist Drift Magnitude values. Support for finding the sneaky path has already been developed, so future work can integrate the different kinds of paths into the story by giving the author a preview of the path.

References

[1] A. Singh, R. Kaur, Peter Haltner, M. Peachey, M. Gonzalez-Franco, J. Malloch, D. Reilly, "Story CreateAR: a Toolkit for Spatially-Adaptive Augmented Reality Storytelling", Graphics and Experiential Media Lab, Dalhousie University, Halifax Canada and Microsoft Research, Redmond, Washington, March 2021.

[2] Turner, A., and A. Penn. "Evolving Direct Perception Models of Human Behavior in Building Systems." Pedestrian and Evacuation Dynamics 2005, n.d., 411–22. https://doi.org/10.1007/978-3-540-47064-9_39.