Project Proposal Document (AR)ails

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Abstract

In this proposal, we discuss the problem space and our motivation for building ARails, an Augmented Reality game to build tracks and simulate vehicle motion within the current physical environment. We evaluate the project by breaking down the features, timeline, and budget, enumerate challenges we foresee, and summarize feedback received about the proposal.

Problem Space and Applications

Hololens is one of the first Augmented Reality (AR) platforms and just started shipping to developers. As such, there are very few apps for the Hololens and AR in general. Due to the newness of the technology, there isn't a set of "best practices" for interactions. An application that enables users to build 3D systems in 3D space will push the boundaries of what the Hololens is capable of providing to consumers.

For digital systems, building tracks in a 2D space can be difficult to visualize because it's a 3D concept, requiring projection. The current available options for this type of game are mainly computer games such as Roller Coaster Tycoon and NoLimit. While these games allow you to pan around the scene, and view from different angles, the experience is far from immersive. Additionally, these applications can only exist in a virtual space, and cannot (easily) incorporate elements of the physical world. They do have various benefits like quick saving and sharing functionalities, as well as the ability to build things without concern for physics.

Another option for this building experience is physical systems, such as train sets, hot wheels sets, and K'Nex. While these do exist in the physical world, and allow much easier visualization/conceptualization, they have their own set of drawbacks. Among these, set functionality is constrained, both by the laws of physics, as well as by what pieces you have purchased. Beyond this, kits typically consist of smaller pieces, which

can pose choking hazards for small children on top of requiring space and cleanup. Additionally, their physical nature denies them the ability to save, clone, and undo. The cleanup with physical sets is also substantially slower.

Potential Solution

We propose building an augmented reality game that allows users to create tracks, and simulate vehicle motion within the current physical environment. Building this app will contribute towards widening the scope of available applications on the HoloLens. Using AR allows us to use many of the benefits of physical and digital analogs to minimize the disadvantages of each, resulting in a more immersive and enjoyable experience. Creations can be 'located' within a builder's local environment, and even react and adjust to better fit it (e.g. tunnel through surfaces, allow portals in walls). This allows creators (and experiencers) to better visualize and conceptualize the creation, and ultimately experience it in a more realistic but flexible fashion. The digital nature allows us to add unique capabilities, which cannot be mimicked by physical kits. This can include functionality that ignores or modifies physics, special effects, teleportation/portaling, and more. Additionally, users can gain access to numerous digital benefits, such as saving levels, undoing actions, easy cleanup/reset, and sharing/remote collaborative functionality.

Example Scenarios

Scenario 1

George and his daughter, Rachel, are spending a day together. Both of them put on their hololens units, and build a roller coaster. George starts in the living room, while Rachel builds in the kitchen. Their two designs meet up in the hallway, and they get to watch their roller coaster zoom around the pots and pans, dip into the sink, corkscrew through the hallway, and glide to a stop on the couch. As a bonus, when friends come over later in the evening, there is both no need to clean up, and they can also show off their creation.

This scenario highlights the potential of multiplayer creation, allowing the two to create one gigantic roller coaster, working on separate parts in the same location.

Scenario 2

Hannah is stuck inside on a rainy day. Instead of turning on the TV, she puts on her hololens, and builds several roller coasters in her living room. As she finishes each, she sends them to her friend, Elise, who tries them out at her place. Elise responds with some designs of her own, and they spend the afternoon making crazier and crazier designs, even working simultaneously on the same coaster.

This scenario highlights the sharing potential of our application, not only allowing the girls to send each other roller coasters to play with, but also allowing them to simultaneously edit the same coaster, from geographically separate locations.

Scenario 3

John and Cindy are moving into their new house, and have lots of boxes to unpack. While working, they take frequent fun breaks, and take turns building up a roller coaster around and through all the boxes. As boxes get moved around, and removed to their ultimate locales, more and more of the coaster gets revealed. In the middle of all this, the furniture arrives, and gets put into the room.

This scenario highlights the potential for our coasters to take into account the layout of the room, and adapt to the presence/absence of boxes and furniture. As the couple continues moving in, the coaster adjusts to work with the new room (portaling through a newly place couch, for instance)

Scenario 4

Josh and Lula, twins and sibling rivals, are pretty competitive in all things. After getting a Hololens for Christmas, they quickly discover our roller coaster application. Playing around, they learn they can compete in building, in a variety of ways. First, they each compete to build the (long|tall|curvi)est coaster given 20 minutes each. Next, they learn that they can race each other on tracks they've built, and proceed to challenge each other. When they get a second Hololens on their birthday, they can even race simultaneously.

This scenario highlights the potential for the building to serve as a platform for competition. This could include building contests, with various metrics, as well as some form of racing on tracks.

Features

The initial features that we want to explore to make our railway building app immersive are for the user to be able to:
- Place tracks
- Use the spatial mapping of the room, occluding tracks that are behind real world objects
- Simulate an object moving along the tracks with realistic motion and physics
- Incorporate spatial sound effects
- Add texture and visual effects to the tracks

Some extra features that we want to incorporate and explore:
- Allow multiplayer collaboration
- Incorporate racing
- Additional track types and obstacles like portals or waterfalls
- Play a 1st person perspective of what riding the track would be like
- Transferring tracks between locations so multiple people can
- Switch tracks between different types of renderings. For example: dominoes, water, fire, etc.

Timeline

Weeks 1-2 : Proposal and learning the technologies
Weeks 3-4 : Rapid Prototyping
Weeks 5-7 : Implementation
Weeks 8-9 : User Testing and Refinement
Week 10 : Ship and Present

Challenges

Designing an interaction for building

Our project, at least in the early stages, will be more focused on allowing a user to design and build a roller coaster track. One challenge will be designing a natural interaction for placing tracks. Since defining new gestures is difficult, we will need to try different user-interaction models with the current set of gestures.

Adjusting to environmental changes

Since users will be designing tracks around elements in the physical environment, we will need to think about how to handle changes in the environment if a user wants to build a roller coaster over multiple sessions.

We will also need to consider how to handle interruptions in the environment. In some hololens applications, when a person walks through your hologram, they cast a shadow that blocks out part of the hologram. We aim to design an experience that encourages users to interact with the tracks as if they were physical, but having a person walk through your tracks and "black out" part of it can destroy this illusion. We will need to design a way to account for interruptions that does not draw too much attention to the holographic nature of the user's creations.

Moving Creations

Another challenge will be saving and sharing creations when users want to move a creation between rooms, or when they want to edit the creation in different locations.

Designing ways to enjoy the finished creation

While our goal is to create an immersive and enjoyable building experience, we will also want to consider ways that the user can enjoy their creation after finishing building. One obvious approach is to allow them to simulate use of their track. First, we can allow them to view this simulation from the same perspective as building, allowing them a 3rd person perspective, and enabling them to walk around the track as it runs. Next, we can explore options for 1st person perspective views. This will require experimentation to determine the most enjoyable methods, but could include allow the user to watch a simulated first person perspective on various screens, ranging from holographic simulated screens and VR headsets, to mobile devices and monitors. Another approach we can take allows the user to use the track for some form of racing, in a single or multiplayer capacity. This could take the form of timed runs, or even Mario Kart style racing, but will require us to experiment with different options, and different methods for controlling the game.

Resource Budget

PC games ($100)

We plan to spend a small portion of our budget ($100) to buy popular PC games (NoLimits and Roller Coaster Tycoon World) that are already on the market in order to better understand this space. NoLimits is a game that models realistic roller coaster tracks, and allows the player to experience the ride in first person. Roller Coaster Tycoon World was one of the games that inspired our project idea, and it will be good to see what this game does well and how our project might build or differ.

Miscellaneous Items ($32)

We plan to spend $12 to purchase a domain name, and $20 to purchase pocket-size battery packs so that we can be free to move around a larger space while developing for long stretches of time.

Assets ($868)

We plan to spend the rest of our budget buying assets for the roller coaster tracks and roller coasters, and assets/sounds for special effects.

Proposal Feedback

We presented the above to a panel consisting of CSE599v1 course staff and engineers working on the Microsoft Hololens. The main feedback was that our project scope was ambitious, and starting with the simplest possible building blocks was highly recommended. Discussion around how track building would look like generated some interesting ideas, such as drawing out a track with your finger in 3D space, starting with a base round track and manipulating it, snapping fixed length pieces together, and providing pieces of preconfigured tracks to enable fast creation. Each interaction comes with pros and cons, which we will consider these during the prototyping phase, as well as refer to HoloStudio for inspiration. Everyone was excited about the ability to break the laws of physics and the ability to easily change the rendering of a path. One idea was to even render the path as a domino chain.