SpandX

Project Proposal

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Introduction

SpandX is an interactive table with a spandex surface, which users can interact with to distort and manipulate a projected display of the solar system. Children are typically introduced to space and the universe in grade three; and through SpandX, primary school students will be able to learn the basics of physics and astronomy in the universe. SpandX encourages learning through play and exploration, aiming to provide teachers and students with a platform that allows for kinesthetic learning to take place.

Background Material

The conception of this project resulted from the discussion and observation of various existing modes of interaction. As a team, we concluded that the traditional classroom setting was outdated and dull and we wanted to solve this. We wanted to create an educational tool that is engaging and allows for a unique interactive experience that does not involve the use of screen. Countless examples were discussed by the group, many of which did not completely satisfy our criteria. However, a couple of inspirations eventually appeared and incited the eventual project conception of ‘SpandX’.

Inspiration

Firewall by Aaron Sherwood

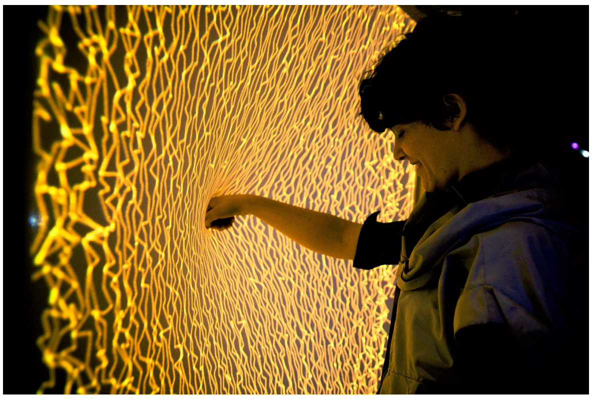
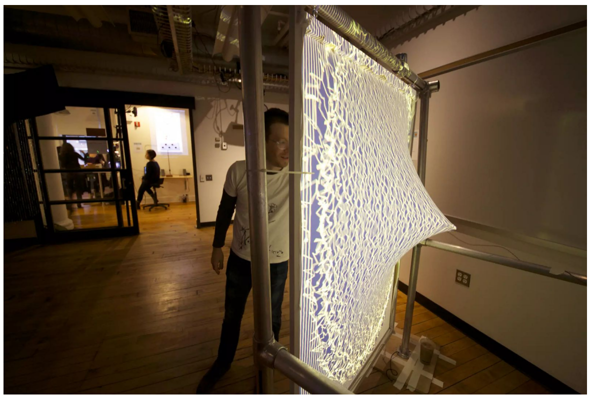



Fig. 1 and 2 (New Atlas, 2013)

Firstly, the Firewall by Aaron Sherwood gave inspiration to the initial mode of interaction for the product. This involves a sheet of spandex that somebody can push, stretch and touch with their hands and fingers to play music. This mode of interaction, how it offers horizontal and vertical interaction, and how the visuals respond to its use, opened up a wealth of potential uses for this technology in the realm of the project.

CodePen - Gravity Points

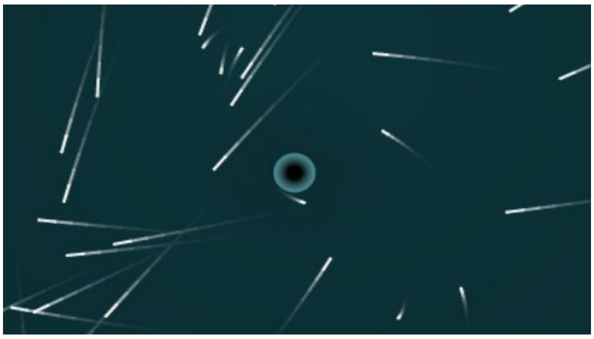
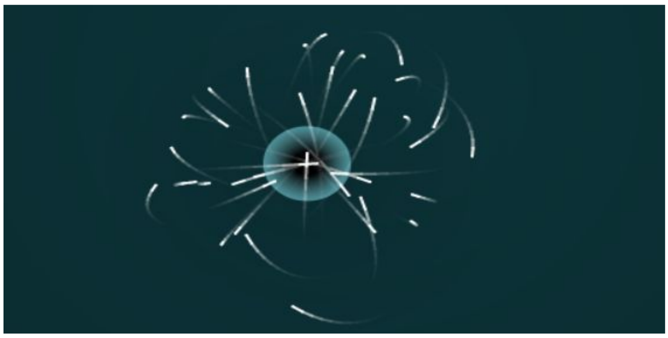



Fig. 3 and Fig. 4 (Hamamuro, 2017)

Gravity Points gave inspiration to the way in which gravity can be controlled in a piece of software. The game involves the creation of objects, you can adjust the mass of these objects, thus increasing their gravitational pull. Doing so will pull any other objects that are within range into the gravitational field.

Kerbal Space Program

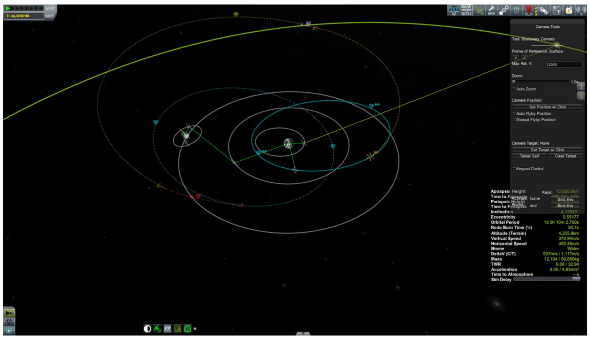
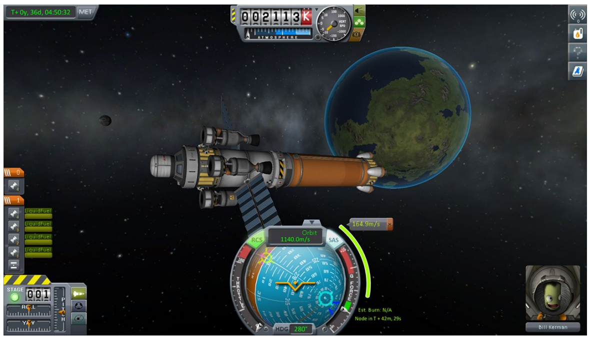



Fig. 5 and 6 (Sony, 2017)

Kerbal Space Program helped to inspire the concept of gravity manipulation and other physics based systems. The game utilises a simulated galaxy in which game objects can be navigated through with the usage of gravity and human based tech. Kerbal Space Program is also a Unity based game and as this is currently our platform for the project, it serves as a good example of what can be achieved with the tech.

Overall, these inspirations all served to help formulate the idea of SpandX. Together they help to represent different facets of what will make this project special. The Firewall represents the tangible interaction that is being utilised, Gravity Points represents the playful experimentation we want to encourage with children and Kerbal Space Program represents the technical and scientific aspects of physics and astronomy we want to help children to learn. Ultimately, through the culmination of these three inspirations, a new product will emerge that enhances the experience of the original inspirations. Games such as Kerbal Space Program and Gravity Points, would have a fundamentally tangible form of interaction that utilises kinesthetic movement. Additionally, the Firewall would be enhanced by giving the original interaction further depth in regards to software, ultimately giving the installation a higher purpose in function.

Scope of Concept

Central Themes

SpandX revolves around the primary theme of early learning with a focus on

Intended Audience and Relevance to Theme

The target audience for this product are children of a prep to early primary school age. Children of this age utilise learning through play and movement; this product will be highly dependant on utilizing this mode of learning by providing a technology which requires vast body movement to play in digital environments.

Context

Context for this project involves the design and creation of a physical installation that allows for a unique and distinct way for people to interact with and manipulate digital worlds. Children will encounter these surfaces in a traditional classroom setting, where a teacher can instigate or encourage creativity and experimentation during specific science or art-based curriculum. An example for how this can happen could involve a teacher giving students a specific goal to achieve, splitting them up into small groups and having each group interact with a surface. Potentially, this concept could overhaul the way in which young students are introduced to the concepts of physics and astronomy. Learning, not through being told but instead, through interaction and observation. While this concept might not completely replace traditional teaching methods, at the very least, SpandX will be an alternative or supplement current teaching methods.

Goals

The goal is to give children the tools to be able to experiment with simulated physics and environments so that they can understand the basics of science and physics through fun and creative means. The product also needs to display a high level of interactivity. The type of software that is used to display the technology must use the mode of interactivity supplied (the spandex) to its full potential. It is essential that this technology is displayed in a way that shows just how unique this interactive experience will be.

The core experience of this product is going to be one that is highly physical and tangible. It is essential that the person interacting with the surface can use extensive body movement and gestures to achieve output otherwise not possible on a traditional touch surface. The major factor here is the verticality of the surface. The flexible cloth allows for a person to use significant depth in their interaction that is simply not possible on a regular flat touch environment. It's for this reason that is is important that the final product software wise is demonstrating this verticality to the fullest extent.

Components of Concept

Spandex

This will be the main interaction interface. Because of its elastic surface, children will find it easy to press down on it. While SpandX can be pressed forward and backwards, left and right, it can only move down as opposed to up. There is no pulling aspect to SpandX. As a result, anti-gravity and repulsion cannot be simulated on this surface

Kinect

The Kinect will allow the program to register the depth that the spandex has been pushed. This information will be sent to Unity to be registered as a gravity point depending on how far it has been pushed. The minimum Kinect distance is 50 cm so the table will have to be quite elevated. This might prove a little difficult for children due to their height. This can be solved by using platforms for children to stand on or by using a different depth/IR sensor with a closer sensing distance. By placing it under the spandex sheet, it falls prey to children falling/crawling under the table and displacing it such that the program might go awry. This can be solved by a) placing a barrier around it or b) simply moderating the use of SpandX ensuring that no one tries to kick it out of place.

Projector

Through this program, users will receive real-time feedback by way of projections onto the spandex surface. Images such as specific points, areas, gravitational waves, planets, etc. will be projected onto this surface from underneath. As an example, if a user pushes down on Mars, the gravitational pull is increased and after a certain amount of time has elapsed, the planets and stars rotate around Mars. While we as a team don't have much experience with projector, there is a worry that they will overheat. The projector faces the same potential issue as the Kinect in that it might be kicked or moved - whether accidental or deliberate - resulting in a projection problem. The same solution also applies.

Unity

Unity is a game engine which supports 3D development as well as 3D inputs. Kinect SDKs from the Microsoft website are available for Unity. Each team member has experience in developing on Unity in C# albeit in 2D. As mentioned before, none of the team members have used Unity to develop 3D projects nor have they used C# comprehensively for a while. As a result, the team will have to learn to develop in both environments.

Table Frame

The frame will be constructed predominantly of wood out of familiarity and ease of use. There will be metal involved in reinforcing the overall structure to prevent the table from falling over in case children decide to press too hard. The aforementioned barrier around the Kinect and Projector will be used to protect them. There arises the issue of the table itself moving rather than the inner components being moved. A solution is yet to be discussed but they appear to revolve around using an adhesive to keep them table legs in place.

Constraints

There are a variety of constraints that are apparent and will need to be addressed for the project to reach its ultimate conclusion.

Practical Constraints

Children —and other destructive people—could easily demolish SpandX by doing a myriad of things. Despite the extremely flexible nature of spandex, pressing exceedingly hard could cause the spandex to rip apart, especially at the edges. The boundary case of having too many people press all at once could result in a malfunction. If someone kicks the table, we'd have to re-calibrate the kinect, wasting a large amount of exhibition time and exuding an awkward sense of embarrassment. These practical issues will be tested thoroughly during user testing to work towards robustness.

Whether or not we can even assemble the table is a question to be answered through the process itself. Combining fabric with woodwork will prove to be a challenge but one to be weathered nonetheless.

Technical Constraints

Another significant constraint will be how the projection is distorted when a person interacts with the surface. Further testing will need to be employed but as of right now, it can be suspected that the image projected onto the spandex could become quite distorted when the light distance is changed by moving the spandex. This would create distorted images that are misshapen and not aesthetically pleasing.

It's also important to note that everyone in the group currently has no prior Kinect experience and will have to undergo significant research in order to fully understand the scope of working with Kinect. This could potentially be quite time consuming and ultimately a hindrance on the project. A solution to this problem is to make full use of the resources at hand, including full utilization of University resources such as computer labs, class time and course tutors. Employing use of these resources will help to maximise development and learning time.

Theoretical Constraints

The goals as outlined above revolve around the idea that children will further their creative exploration, deepen their social connections and for the teachers to increase their awareness of the children and their social dynamics. A plethora of child psychology and social learning theories can be implemented with these as primary goals. Research will have to be conducted but at such a primitive stage in the design process, nothing can be guaranteed. The questions we *can* pose, however, are as follows:

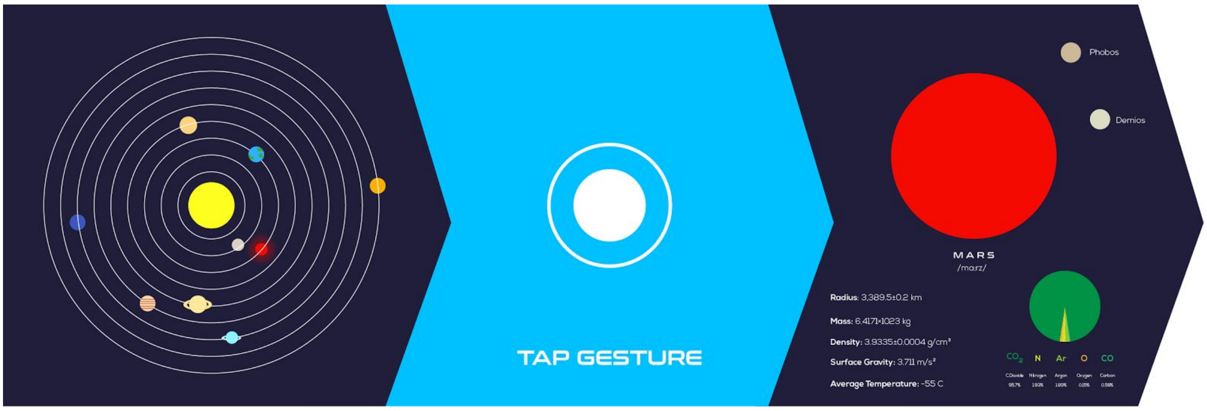
- Which student, at the end of the session, progressed the most socially?
- Was there one student who motivated students more than others to explore?
- Is this normal behaviour to the children?

Limitations

While SpandX is able to manipulate the gravitational pull by increasing it, there's no way to decrease the gravitational pull. While this isn't considered a major issue, it presents itself as a limitation.

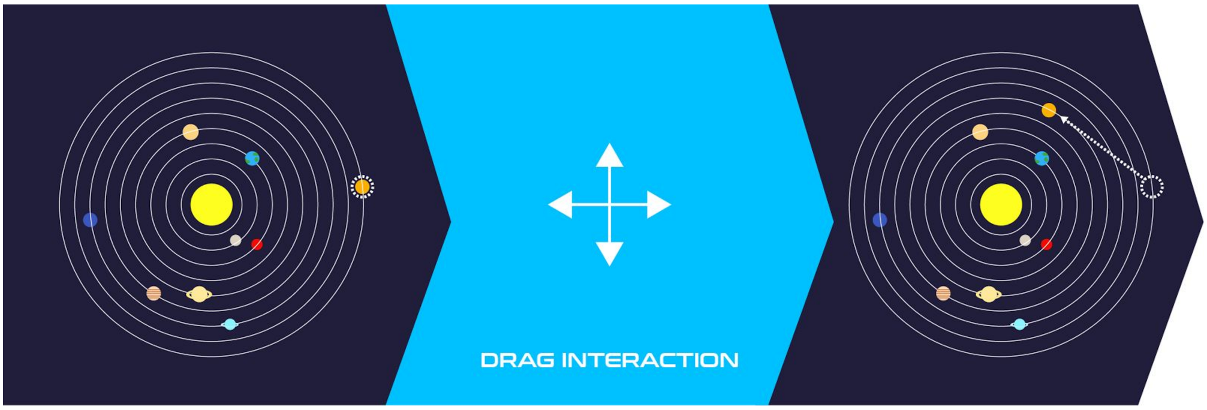
Interaction and User Experience Walkthrough

Users will interact with the spandex surface by applying pressure onto the sheet to manipulate the planets on the spandex sheet. Physical grasp on data - experienced-based.

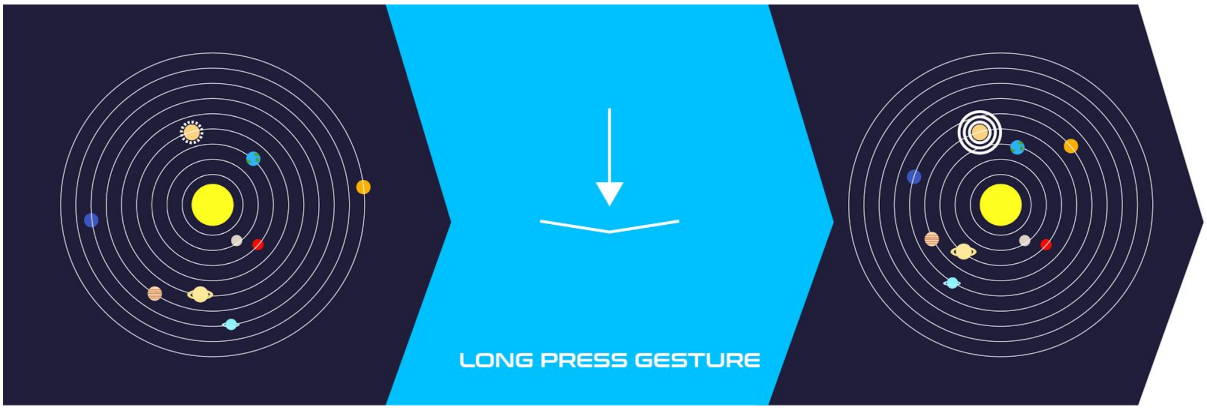


The first interaction that users will encounter on the spandex surface is a projection of all the planets in the solar system revolving around the sun leaving colourful trails behind them. Mars will emanate a pulsating glow to indicate to the user that this is an important interaction element. When the user taps on Mars, the name of the planet and information about it is shown. Details include:

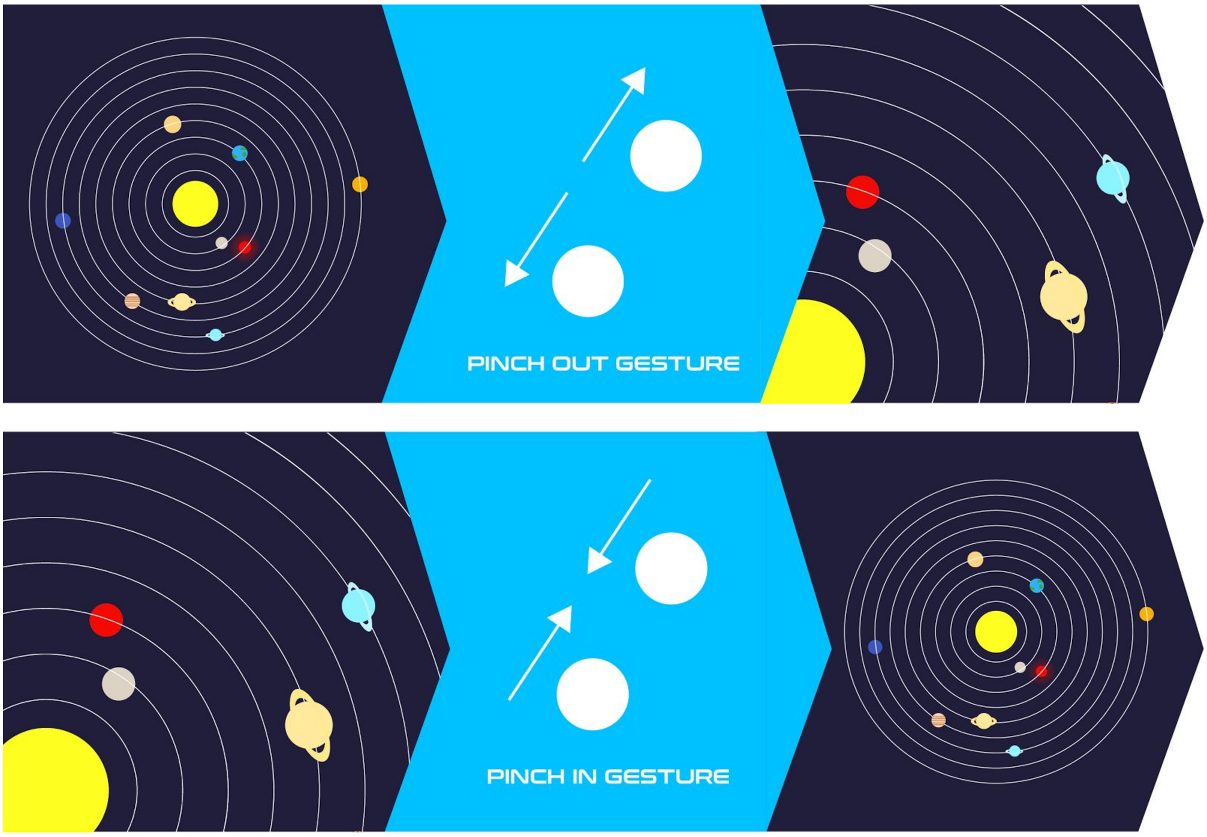
- Radius
- Mass
- Density
- Gravity
- Number of moons
- Average temperature
- Composition
- Signs of life



If the user holds on to the planet, other planets come to a halt, allowing the user to move it to change its position. The planets would start revolving around the sun again and the user will then be able to visualise the effects when a planet becomes displaced.



The user can press down on a planet to temporarily manipulate gravity by increasing the gravitational pull of the planet. This would cause the other planets and stellar objects to begin rotating around it instead of the sun. When the user lets go, the spandex will go back to it original state and the planet's gravitational pull will go back to normal.



The user can carry out generic gestures (similar to mobile devices/touch screens) like pinching to zoom in and out, and swiping to navigate around the solar system.

Upon resetting the universe to its natural heliocentric state (thanks to the reset button on the top right hand corner)

Project Plan Breakdown

Due	ID	**Milestones**/Task	Member(s)	Hours
5	**1**	**Final Concept Decision**		
	1.1	Reflect on feedback	All	8
	1.2	Group Discussion	All	16
	1.3	Research new options	All	12
	1.4	Decide on final concept design	All	8
5	**2**	**Complete Proposal Document**		
	2.1	Write introduction	Mitchell	1.5
	2.2	Write constraints section	Gabby	1.5
	2.3	Write Project Plan section	Andrea	1.5
	2.4	Create mockups/sketches	Eddie	1.5
	2.5	Write contribution statements	All	4
6	**3**	**Initial Prototypes/Testing**		
	3.1	Create prototype of all interactions	All	2
	3.2	Set up table frame	All	1
	3.3	Bodystorm interactions using prototypes	All	8
	3.4	Record bodystorming	Mitch	12
8-9	**4**	**Presentation**		
	4.1	Prepare script and mock-ups for presentation	Eddie	8
	4.2	Prepare powerpoint for presentation	Gabby	4
	4.3	Edit video from bodystorming and other recordings for documentation	Mitch	3
	4.4	Practice presentation	All	3
8	**5**	**Obtaining Technology**		
	5.1	Research the best technology suitable for the experience	Eddie/Mitch	2
	5.2	Find and acquire tools/tech required	Eddie	3
7-8	**6**	**Asset Development**		
	6.1	Create program/game on Unity	Eddie/Mitch	8

	6.2	Design/create visuals	Andrea/Gabby	7
9	**7**	**Developed Prototype Testing**		
	7.1	Test	All	4
	7.2	Analyze and observe	All	2
	7.3	Analyze feedback	All	2
10	**8**	**Interactive Elements/Unit Testing**		
	8.1	Gestural Controls	Eddie/Mitch	4
	8.2	Test Gestural controls	Andrea/Gabby	4
	8.3	Test code	All	8
	8.4	Make Adjustments to code	All	8
11	**9**	**Video/Storyboard Presentation**		
	9.1	Prepare storyboards/video	Andrea/Gabby	4
	9.2	Analyze feedback after presentation	All	4
12	**10**	**Finish installation**		
	10.1	Put all elements together and do a run through	All	16
	10.2	Run through final user testing	All	8
5-12		**Attending scheduled class sessions**	**All**	**252**

Resources

Cash and other expenses will be distributed respectively across the team.

Team Contributions

Each team member will be assigned specific roles based on personal skillsets, however, are encouraged to contribute to any and all other roles and responsibilities.

Team roles and responsibilities

Team member	Roles and Responsibilities
Andrea	Graphic, Interface Design and Physical Construction
Eddie	Unity Development and CAD Designer
Mitchell	Graphic Design, Unity Development and Physical Construction
Gabby	Unity Development and Graphic Design

Individual Paragraphs

Andrea

Andrea is currently completing her final semester of a Bachelor of Multimedia Design and has focused on web development, information systems, and communications during her studies. She has experienced with Adobe Creative Suite programs, web development languages and tools, and has studied programming in Java, Python, and ActionScript. She is the designated graphic designer for this project and will be helping out with the physical construction of the concept.

Edward

Edward (otherwise known as Eddie) is a third year Human Computer Interaction student. As a jack of all trades, Edward has experience in both coding and design. Having briefly experimented with Google Sketchup, he is the designated CAD designer despite having limited experience. Where he lacks (excessively) in public speaking, he gains in quick and complex thinking and a passion for teamwork.

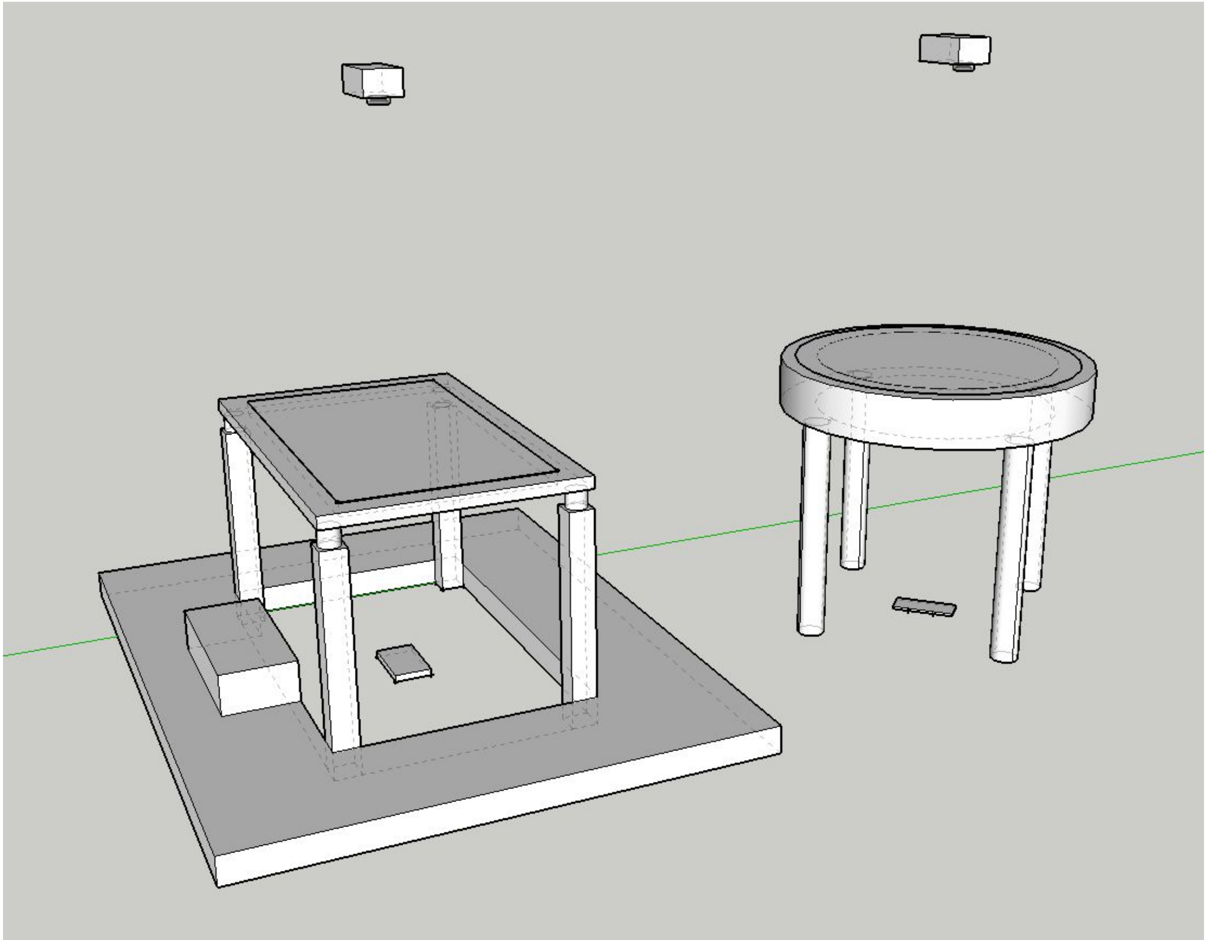
Gabby

Gabby is a third year Bachelor of Multimedia student, who is passionate about designing and developing. He is the designated Unity developer and graphic designer for this project, but is flexible enough to handle most tasks. Gabby can come across as an introvert or lacking in discussion, as he is not too picky with group decisions, goes with the flow of the team, and likes to analyse quietly in his head. Nonetheless, he rises in the face of challenges and always creates a way to succeed.

Mitch

Mitch is a third year Multimedia Design student with extensive experience in the realm of media creation and software design. His skillset comprises of considerable experience in the use of the Adobe Creative Suite, a strong understanding of software design and adept software development capabilities. He enjoys collaborating with other people in order to develop ideas that are both challenging and highly rewarding.

Mockups



Our concept, SpandX, is basically a table with a spandex table top. A projector will be placed overhead to project the Unity program onto the spandex surface. A kinect sensor will be placed face up under the table to detect depth. Two mockups for our concept have been generated, the first one is a rectangular table top with a platform surrounding it which allows children to be able to reach the surface of the table. The second one is a round table which would allow for a better shape to project our program onto.

Link to GIF of mockup: https://gfycat.com/CoarseReflectingAmericanshorthair

References

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