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Technical games development
Final year project

Project title:
Snowsports plug in development through the use of forces

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Contents

Contents	2
Introduction	2
Research review	4
Real world applications of the physics	4
Relevant game genre research	4
wider research examples	5
Development	6
Concept and planning	6
Implementation	6
Testing and feedback	12
Evaluation	14
Result	14
Future additions	15
Bibliography	15



Introduction

The aim of this project was to produce a scripted system for character movement which would reflect a realistic snow sports experience for the player. The intent was to create a system which would be easily implemented by a developer with a basic knowledge of the technical blueprints within Unreal engine 5, for example if a third party animator wished to create only animation this system would be used for the character movement and controller mapping allowing them to reach their animations full potential without having to focus on scripting.

To stay true to this intent the project needed to stay intertwined with player testing and feedback to ensure the system felt natural and realistic to hold its place within a snow sports game, It was also imperative the project retained its ease of use when being given to a less technical developer, allowing them to adjust values and force multipliers within the project without having to make changes within the base blueprints.

The main software used to create the gameplay and level design was unreal Engine utilising the blueprinting system to create the main project functionality as well as the landscape sculpting tools to create the two levels used to showcase the mechanic.



Research review

When conducting research for this project the sources used were split into three main sections:

Real world applications of the physics

One medium used for research was videos and articles of snow sports as well as skateboards which allowed a broad understanding of how a players body position and movement over a central point would be reflected in their turning radius and speed. For this I used videos such as relatable riding(Moore) and alpine decants (Neumann). As well as articles detailing the basic physics of snowsports and how the position and shape of a snowboard affects its interaction with the ground changing its direction and speed. ("Physics of Snowboarding") was especially useful and detailed the different implantations of forces within snowsports as well as how a riders experience level would translate to their speed and maneuverability.

Relevant game genre research

The main focus of research for this project was into games implementing a similar or the same concept. The two main examples of such games were Steep(2016) and SSX Tricky(2001) These games both received high reviews from their player base, and due to the game experience have been able to retain a strong player base for almost a decade after their respective releases. Steep received high reviews with players calling it 'Thrilling ' and 'a delight'"Steep." ("Steep") this game heavily influenced this project due to personal gameplay experience as well as its wide standing within the gaming community allowing players of the project to relate the mechanics to a fully developed gameplay experience they had previously had.

SSX Tricky was also chosen as a research point due to personal experience with the game play as well as the fact that the player base has remained strong and active for such a vast amount of time which is a testament to its design. It received an overall score of 91 ("SSX Tricky") with reviews calling it 'addictive' and 'exhilarating'.

The mechanics of SSX tricky as well as Steep have both been credited for their accuracy to real world instances as well as their player engagement and have laid the foundation for this project allowing it to build off of existing methods for feedback to

the player and the reflection of body position, speed and manoeuvrability within the product.

wider research examples

Another form of influence on this project was games from wider genres which focus on movement for example apex legends with its movement mechanics and the level of skill required to utilise them to their fullest, spider man PS4 which showcased an ability to implement a movement mechanic which allowed for players of all abilities to thrive. Spider man PS4 implemented the swinging mechanics into the game so it would be simply understood by younger or less experienced players however it still remains fun for more experienced gamers through the use of tricks and specialist methods to gain speed and navigate the map quicker.

Moving even wider from the project, personal experience in rock climbing also influenced this project as it was a great asset to have a deep understanding of how the body's movements affect balance and weight distribution. This was especially beneficial as the experience gives a relatable and real experience of movement of the center of mass to complete moves in the smoothest manner possible and remain on the wall.

These three focuses allowed for a wide range of influences on the final result of the project and came together to produce a well rounded and natural game feel which was accessible to players with varying levels of gaming experience.



Development

Concept and planning

Tr	Task	Priority	Status	Start date	End date	Tr	Milestone
	complete proposal	P3	Completed	m/d/yyyy	2/4/2025		Milestone
	First working prototype of mechanic	P3	In progress	m/d/yyyy	2/25/2025		able to complete first round of player test
	Create first block out of level/course	P3	In progress	m/d/yyyy	2/25/2025		able to complete first round of player test
	UI timer created	P2	Not started	m/d/yyyy	2/25/2025		Milestone
	Progress review submission	P3	Not started	m/d/yyyy	2/25/2025		Milestone
	first play test	P3	In progress	m/d/yyyy	m/d/yyyy		Milestone
	Continue development of mechnic based on feed	P3	Not started	m/d/yyyy	3/13/2025		complete second wave of test
	gather and implement assets for level	P1	Not started	m/d/yyyy	3/14/2025		complete second wave of test
	Menu ui initial implementation	P1	Not started	m/d/yyyy	3/14/2025		complete second wave of test
	completion of player mechanics	P3	Not started	m/d/yyyy	3/28/2025		third testing wave
	completion of level	P2	Not started	m/d/yyyy	3/28/2025		third testing wave
	completion of UI elements	P2	Not started	m/d/yyyy	3/28/2025		third testing wave
	Polishing player mechanics	P3	Not started	m/d/yyyy	4/7/2025		for final hand in
	polishing level	P3	Not started	m/d/yyyy	4/7/2025		for final hand in
	prototype submission	P3	Not started	m/d/yyyy	4/28/2025		Milestone
	report submission	P3	Not started	m/d/yyyy	5/6/2025		Milestone

fig1^

The initial concept for the project remained consistent throughout however the plan was altered on several occasions due to issues outside of the university. At the beginning of the project a detailed plan was created and laid out which assisted in the initial implementation and development of the project. Tasks were organised by priority and a predicted start date, the majority of them were carried out as intended. One of the main issues which led away from the project plan was a lack of play testing opportunities due to an inability to attend some of the tutorial sessions. This is echoed later in the report and was the main issue faced during development.

Despite the deviation from the project plan the main body of the project was completed by the 4th of april leaving time to gather play test responses, skipping the second round of tests and straight into the final. The project initially followed the plan closely with the development of the sliding and forces system completed quickly and later refined.

Implementation

The main issue that was encountered during the development and implementation of the project was the use of forces and impulses within ue5. This proved to be harder to work with than originally thought however through the use of the unreal engine documentation many issues were overcome.

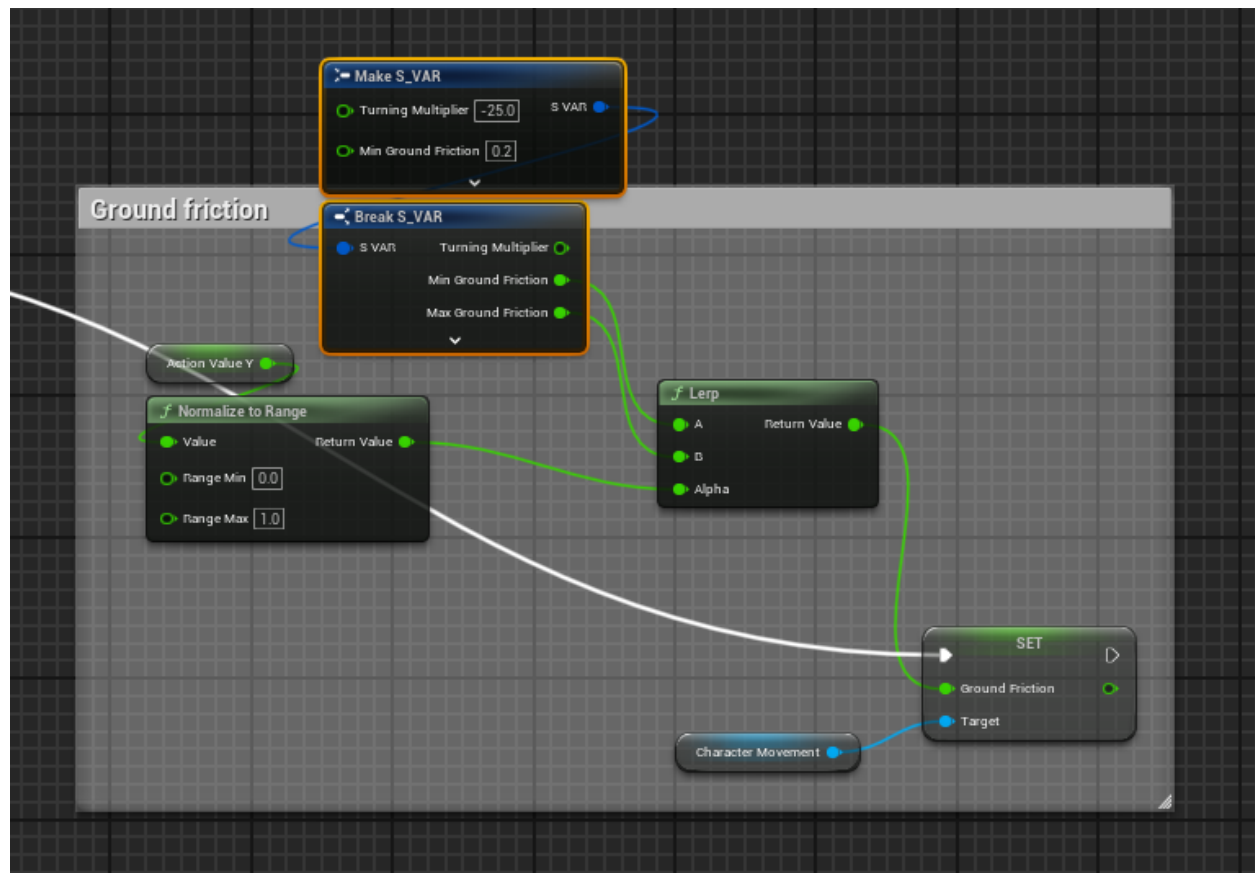


fig2^

One of these issues came in the form of using air resistance, as there is no built in function for wind resistance the project used a version of the ground friction setting from the player movement component to adjust speed based on the players movement along the Y axis with the right joystick. This meant that as a player raised or lowered their body position the ground friction would be adjusted to give an impression of drag due to the air. This was then later refined during testing to create a more natural and realistic feeling using a lerp between two floats which could be adjusted through the separate structure created for customisation within the project. Fig2 shows the final iteration of this system.



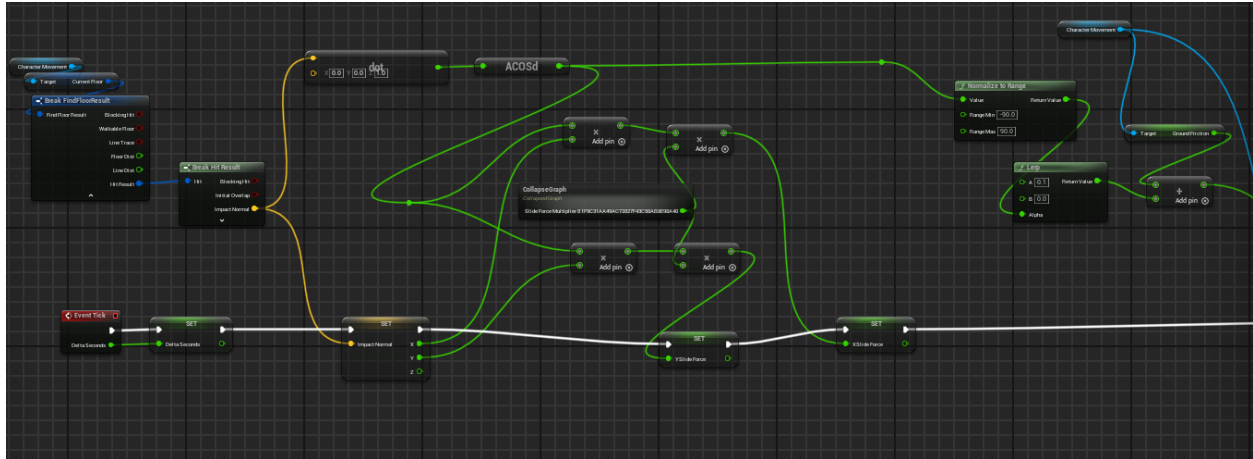


fig3^

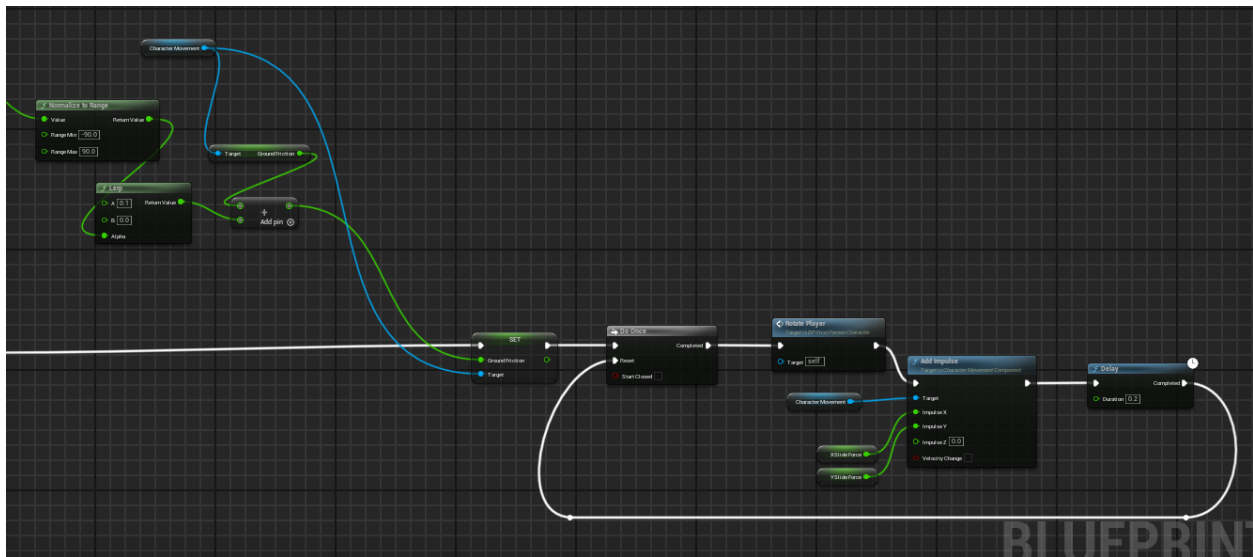


fig4^

The main body of the mechanic was achieved through the sliding(fig2/fig3). This script initially takes the impact normal of the floor the player is standing upon and creates an impulse to push the character down the slope with the equating speed and direction. This mechanic was adapted from a toggleable slide created by Werewolven. (Werewolven) To fit the project the mechanic had to be adapted to be non toggleable as originally a player could activate the slide after sprinting or reaching a specific speed, the multipliers also had to be adjusted to increase and decrease different aspects of the slide to fit a snowsports game feel rather than a form of knee sliding. This was the main focus of refinement and the multiplying values were constantly changing throughout the various iterations of the project



Also incorporated into the main sliding was matching the player rotation to the ground to feedback the direction and decline of the surface(fig4). This feature proved challenging due to the player rotation being limited elsewhere in the blueprint, this was due to the fact that the player could originally spin a full 360 degrees however it made the movement feel forced and unnatural as the player would slide on the front edge of the board/skis without losing momentum or control. This script first took the normal of the floor as well as the player's rotation and adjusted between the two values, the interp speed was essential for this adjustment to not look jumpy and delayed but rather a smooth transition between the 2 vectors. This was later put into a function which could be used in different parts of the script ensuring the player always matched the decline of the slope moved upon.



All of the multipliers and values which affect the player can be easily adjusted within a dedicated structure to promote ease of use by a non-technical designer. The player character at present is also easy to understand and provides feedback to a player or animation of the intended body position in conjunction with the player's movement allowing ease of development from all parties.

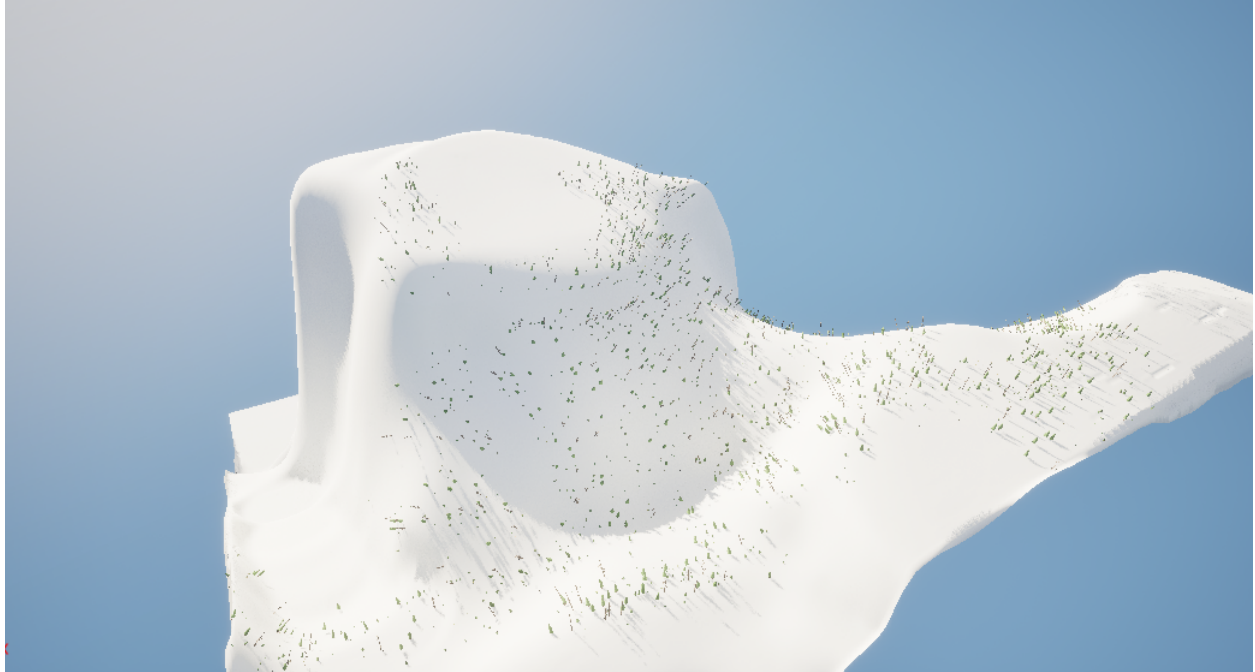


fig7^

The maps shown in the final product were created as temporary test grounds and then tweaked as the project progressed to keep up with the demand of the product. They were made using the Unreal Engine's landscape sculpting tool and then populated with foliage at the request of play testers. This proved to work well for creating a free flowing level that was easy to use but still pushed the limits of the mechanic and identified any errors or bugs. One such bug was the ground collision, this affected the player and caused the character to catch flight if the ground had not been properly smoothed due to the straight edge of the triangular mesh catching the capsule of the player's collision causing it to float in the same direction without losing speed. This issue was resolved through properly smoothing the level however is a pitfall of the project if not tackled correctly.

The project required a basic main menu and pause menu which was implemented using the common UI plugin which allowed for full controller support within the menus and throughout the build. This allowed full navigation throughout the project with a gamepad with no requirement for a keyboard and mouse.



Testing and feedback

How would you rate the overall feel of the snowboarding mechanic? (e.g., smooth, clunky, responsive, unresponsive)

4 responses

- Everything was responsive
- smooth
- It makes sense with the topology
- Twass smooth

Did you feel a sense of speed and momentum while snowboarding? Why or why not?

4 responses

- Yes
- Yes, feels realistic
- the player is moving but does not seem to gain speed
- yes I do, as the incline on the mountains increased so did my speed, provided a real sense of speed

fig8^

Did the physics of the game (gravity, acceleration, friction) feel natural? Why or why not?

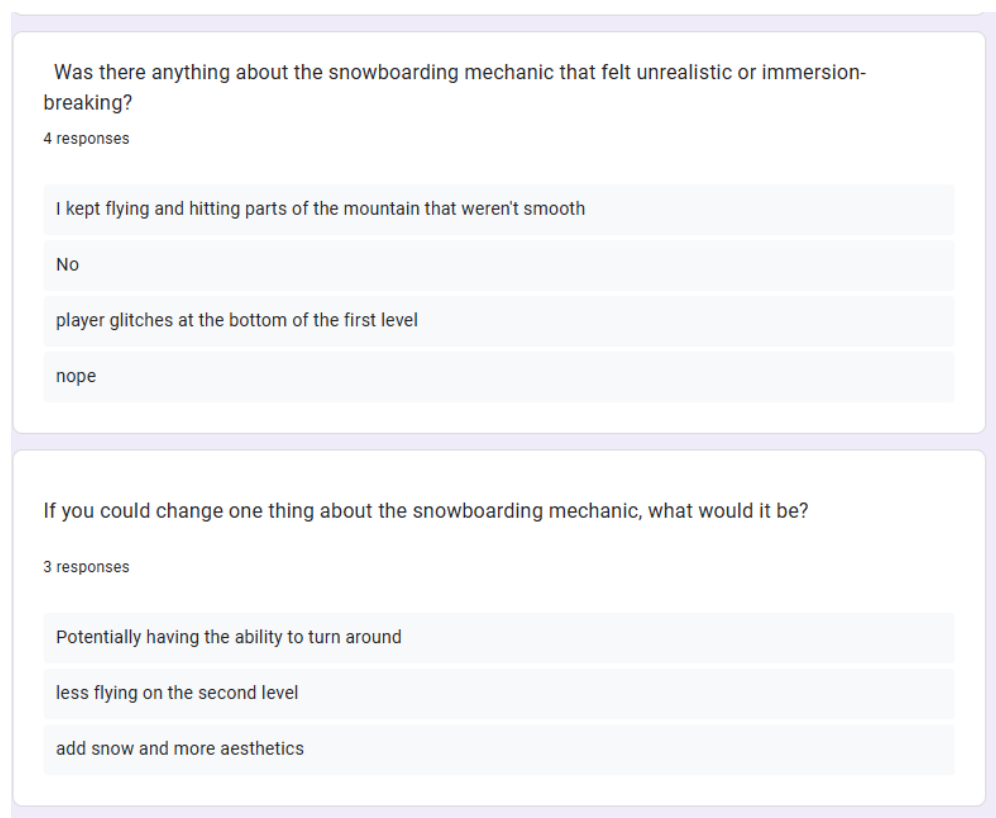
4 responses

- Yes
- Gravity and acceleration feels good. Friction feels a little strange when changing direction
- acceleration was good on the second level but there wasn't any on the first
- yes

fig9^

A vital part of the project was conducting player testing throughout its development however, due to personal issues as well as struggles with the implementation of forces within ue5, the testing was not as thorough as initially intended. From the tests and

feedback received the clear issue with the project was conveying a feeling of speed and acceleration (fig8/fig9), due to this the maps had to be altered to give the player reference points in the form of foliage and trees. This small change allowed for a vast increase in the sensation of acceleration especially when coupled with the later addition of speed lines which were implemented using UE5's niagara particle system progressively spawning more particles based on the players speed. This allowed a players brain a comparison point of a stationary object to see the speed they travelled past it.



The image shows a screenshot of two survey questions. The first question is "Was there anything about the snowboarding mechanic that felt unrealistic or immersion-breaking?" with 4 responses. The responses are: "I kept flying and hitting parts of the mountain that weren't smooth", "No", "player glitches at the bottom of the first level", and "nope". The second question is "If you could change one thing about the snowboarding mechanic, what would it be?" with 3 responses. The responses are: "Potentially having the ability to turn around", "less flying on the second level", and "add snow and more aesthetics".

Was there anything about the snowboarding mechanic that felt unrealistic or immersion-breaking?

4 responses

I kept flying and hitting parts of the mountain that weren't smooth

No

player glitches at the bottom of the first level

nope

If you could change one thing about the snowboarding mechanic, what would it be?

3 responses

Potentially having the ability to turn around

less flying on the second level

add snow and more aesthetics

fig10^

Another bug which occurred regularly was an issue within the rotation limiting and alignment function (fig10). This caused the player to twitch and move between two rotations rapidly causing a confusing and irritating experience for the player. This was diagnosed as an issue with the rotation limiting as the function for capping player rotation ran in such a way to override the alignment to the ground and control by the player. This issue was resolved by changing the order of execution within the blueprint leading to a smoother and less jarring result however the bug still occurs on rare occasions.

Other feedback received was based around the art style of the project and its simplicity however this was intentionally left out due to the intension for this project to be a plug in used strictly for the implementation of character movement. Due to this desire the art and assets used were always intended as placeholders to be overwritten by an outside developer who planned to take the mechanic into their own project allowing them to freely explore their creative vision.

Evaluation

Result

This project successfully met the intention of creating a set of mechanics to be used as a base in the creation of a snowsports game. The initial scope of the project was large however after discussions with my tutor it was decided to approach the project as a plug in rather than as a fully developed game, this allowed focus to be placed on the gameplay mechanics and features, and their development to their fullest potential without sacrificing quality by using time on other aspects such as art and animation. However due to issues unforeseen in my project plan I fell behind schedule for a portion of the project, this allowed for less time and fewer rounds of play testing which may have helped identify issues within the project earlier and allowed for more elegant solutions. In the initial plan the project contained a time trial mechanic however this was dropped to allow more development time on the main mechanic due to the time lost caused by other personal issues, this was disappointing however was the correct decision. The main focus of the project was always its functionality with other pieces of aesthetics and small features being moved to the side to deliver the best possible movement system.

This project has allowed the for the focussed development of skills from previous projects such as beta arcade, in which the main focus of work was character control and movement mechanics, allowing for a more focussed and in depth approach to movement and physics which would not have been attainable if undertaken in a wider game project. This has helped refine existing practical skills as well as knowledge of game theory especially in creating an immersive and responsive sensation of acceleration and momentum.



Future additions

One area for future development would be to use this project to create a component which could be used in a similar fashion to the basic character movement component allowing for a plug and play methodology to be used more effectively. This idea unfortunately came too late into the project for the conversion to be made and instead the structure was used to simplify the adjustment of values to affect the mechanics and allow for tailoring to different projects. The method of creating a component would be implemented if repeating this project and could have elevated the implementation allowing for easier use by third party developers to fit their individual case.



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