

Project Proposal - MComp Research Project - Ashley Cromack - CRO12450621

Investigating dynamic terrain as a novel mechanic to solve puzzles in games within a real-time physics simulation context

Introduction

In the sphere of video games, there is a certain line of thinking that aims to instill as much realism into games as possible, to make them a truer approximation to the world around us and thus deepening the level of immersion that the player feels. One way in which developers try to achieve this goal is to implement a system of physics simulation in their games, this is such a popular component to games now that most games have some form of it influencing the way their game plays and there are even multiple middleware solutions to aid developers' implementation of it into their titles.

In regards to physics simulation, there are a number of approaches developers can take to implementing it. One such way, one which many academics and their subsequent studies tend to investigate, is that of creating the most accurate simulation of real-world physics as possible. This typically involves an in-depth understanding and use of equations and accurately recreating the properties of real world materials, such as accurately modelling soil and how objects such as tires may interact with them. To simulate this interaction as accurately as possible, a large amount of complex operations need to be executed and every small detail needs to be considered at every time step. This tends to lead to simulations that require a greater amount of time to calculate and render each frame than would be appropriate for a video game, which tend to require a response time in milliseconds to achieve a simulation that feels responsive to the player.

Hence, in games that do implement physics simulation, they tend to utilise a more simplified model of how the world operates mechanically (for instance considering objects as simple rigid bodies or particles). This allows the amount and complexity of the mathematical functions involved to be streamlined massively, allowing the simulation to respond much sooner to the players' inputs and thereby demonstrating the impact they're having on the world in real-time, making it a much more viable system for use in games.

One possible use for a physics engine is to model terrain and making it dynamic, allowing the player to interact with the terrain and see the effects incurred on it. However, when it comes to the application of terrain deformation in modern video games, there isn't a wide range of titles to look to as examples. One of these examples is *Spintires* (Zagrebelnyj, 2014), an off-road driving simulator game that tasks the players with transporting cargo through a range of environments. This game utilizes the *Havok* (Havok, 2011) physics engine to simulate how the muddy terrain deforms when the player drives over it, added a depth of complexity to the game as players must be careful not to get themselves stuck. Much like the serious simulations mentioned prior, this game takes a more serious approach to the physics of the world. This means that players will need a decent understanding of how to control their vehicle on a variety of surfaces, such as

wet mud, rocks and water, as well as how the tires will impact the terrain's surface. This can make the game somewhat unfriendly to newcomers, especially those with only a rudimentary understanding of how vehicles behave with terrain, so a more streamlined and simplified approach to this deformation and how to cause it may help to foster the players' understanding of how it works.

One of the most prevalent components to games, one which can often become a genre in and of itself, is that of puzzle solving. Typically, the most popular puzzle games on the market are 2D affairs that utilise a simplistic approach to both presenting puzzles to the user and presenting them with the means to solve them. However, with the advent of *Portal* (Valve Corporation, 2007) in 2007, Valve experimented with developing a whole puzzle game around the simulation of physics (in this case through momentum and how projectiles interact with surfaces). This proved to be an incredibly popular title which, along with Valve's other implementation of a physics engine in their *Half Life 2* (Valve Corporation, 2004) titles, showed that the idea of utilising a simulation of real-world physics as a game mechanic was one that the games industry, and indeed the consumers of said industry, were more than receptive to.

This project looks to investigate physics simulation, in particular the implementation of deformable terrain in this context, and how it can be applied as a principle mechanic in a video game. The key concept of this resulting game will be to present a player with a puzzle to solve and the key tool at their disposal will be the ability to deform the terrain around them, causing them to consider how they can impact their game world to their advantage and be aware of some of the challenges this may throw in their path. This work will therefore be attempting to explore new ground with the way physics systems are implemented in games, using dynamic terrain in this context to create new and unique mechanics in the field of video-game puzzle solving.

Aims and Objectives

The aim of this project is to experiment with the concept of deformable terrain as a game mechanic to solve puzzles, using a real-time physics simulation context to model this in an intuitive way. This deformable terrain concept will therefore be implemented as a novel mechanic to solve puzzles in a game setting and throughout the course of the project the impact on players will be evaluated, investigating how it affects their perception of the puzzles presented to them and how they can solve them using the tools at their disposal.

To meet these aims, the following objectives will need to be met through the course of the project:

- To investigate and experiment with the current implementations of physics systems and middleware to find a suitable basis to build a real-time solution for terrain deformation, such as *PhysX* and *Bullet*. Additionally, to explore ways to implement this system into a game, potentially through existing games engines like *Unity* and *Unreal Engine*.

- The game should go through an extensive design and prototyping process to ensure that it delivers an enjoyable and coherent experience for the players, with focus on conveying the mechanics and how they operate clearly.
- To successfully develop the game into a functioning prototype, demonstrating the implementation of terrain deformation that responds in an appropriate real-time context to the player's interactions with it. The game will be designed with this player-controlled terrain deformation in mind as the primary tool to solving puzzles.
- To evaluate the effect that using dynamic terrain as a game mechanic has on the gameplay experience and how it influences their approach to puzzle-solving. To do this the artefact will need to be presented to a group of play-testers to investigate what their experience with the concept was like, see what components they enjoyed, and which features they gravitated towards, along with more quantitative data from logging their interactions with the game.

Literature Review

Models of Terrain Deformation

While most models of deforming terrain focus on the surface being a form of soil, there are cases where a real-time simulation can be used to deform sand in response to the wind and the vegetation strewn around the environment (Wand and Hu, 2009). This approach's main aim is to produce a visually realistic approximation of a desert; however, they also place focus on implementing the method on the GPU to parallelize the process to make it more suitable in a real-time setting. This use of the GPU to optimise the performance of the physics simulation could be an important consideration to ensure that the game produced in this project performs adequately for the gameplay.

When it comes to modeling the interactions of vehicles with dynamic terrain, there are many established approaches. One such model is investigated in a paper where the academics present a scientific model of how to simulate a tire's interactions with a terrain and how it deforms said terrain (Madsen et al, 2012). Where this approach diverges is that it goes on to present the model in a serious context, measuring the amount of energy or power the vehicle needs to deform the terrain, in order to produce a realistic driving simulator for the military. However, many of the key concepts should still be applicable when developing the dynamic terrain for a game setting like with this project.

It is important to consider that, in these cases of vehicles deforming the terrain, the ground should not only look altered but also impact how objects interact with it. One way is to propose the use of modern GPU features in their dynamic terrain visualization method to alter the topology of the terrain being deformed (Wang et al., 2009). The implementation they achieve purportedly runs at a high frame-rate, making it perfectly suitable for an interactive 3D application, such as a video game as with this project.

In a similar paper, academics once again look at how to modify terrain as a result of interactions with a vehicle, however the focus shifts to implementing it on a larger scale of terrain (Zhang et al., 2010). They specifically use a GPU-based terrain deformation algorithm to help generate said alterations to the terrain, using this in conjunction with shaders and OpenGL. This is a much more manual approach, and fails to produce a visually realistic scene, but it also manages to run at a high frame-rate suitable for games, so it may therefore prove a useful approach to consider when developing the game for this project.

Game Design, Implementation and Evaluation

When designing a game, it can be important to consider an established framework along the way, to ensure that the end result has the desired impact on the players. One such framework in the field of game design is the MDA approach to game design and research (Hunicke et al., 2004). This framework outlines a process of design by considering the game from a data representation standpoint, all the way up to the end experience that the player has, along with the connection between these two things. This system also provides a way to approach investigation and critique of games, which will come to the forefront for the play-testing stage of this project.

An important component to any game is how it is rendered and presented to the player as a complete package, frameworks can be useful guidelines to accomplishing this. One framework proposed by academics looks at the generation, modelling and rendering of a game world (Catanese et al, 2011), one component of which being the support of a physics engine (in this case using the *PhysX* middleware). This framework therefore not only looks at how to produce the game world, but also how to simulate some of the objects within it and the interactions that they can have with each other.

In terms of how to evaluate the effect that a game can have on the players, and indeed the effects of using a simulation of Newtonian physics in these games, it's vital to look at how others have conducted their investigations. In one such study looked into helping people to learn physics by exposing them to computer simulations. In this case they investigated the efforts of the physics-based game *Portal*, measuring whether playing it caused improvements in the player's physics intuitions and spatial cognition skills (Adams et al., 2016). While the results may be important to consider, the way in which they conduct this study can be useful for evaluating this project in the play-test stage.

Particle/Mesh Physical Models

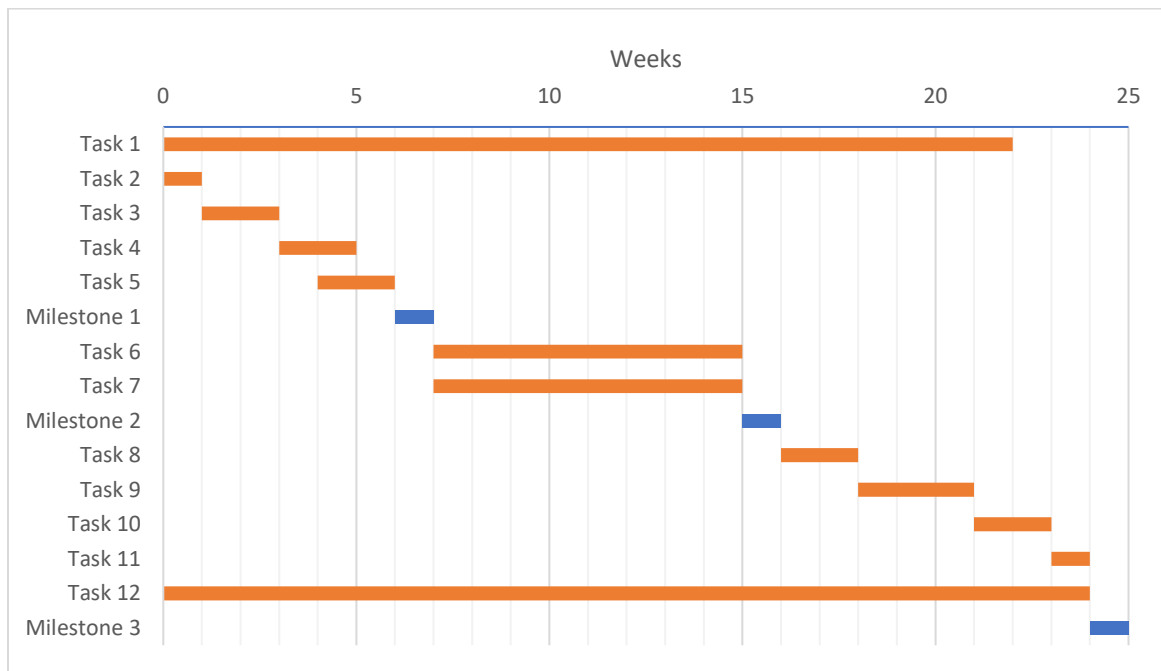
In another approach to modeling dynamic terrain in a driving simulation, a main focus of the paper is on the implementation of such a simulation with multiple displays, however they also detail the process by which they create their dynamic terrain (Ni et al., 2009). In this study they use the Real-time Optimally Adapting Mesh (ROAM) algorithm, discuss how they generate the deformable terrain with this algorithm, the use of height-maps in this system and the step-by-step process in which the terrain mesh is generated. This in-depth look at their approach may therefore be a useful insight into how to generate the dynamic terrain in an adaptable fashion.

A different approach to modeling the ground is to simulate the soil as being loose, using a more particle-based model (Chanclou et al., 1996). Their application of this system allowed the simulated soil to compress and pile, meaning the vehicles interacting with it would leave tracks and even sink into the ground. Employed on a large scale, this solution appears unsuitable for a real-time application, due to its heavy resource overhead requiring multiple seconds to process each frame. However, implemented as a smaller component in a real-time simulation, this system may still be viable therefore it could be a system to investigate for a smaller component of the project's problem-solving gameplay.

As demonstrated with the varying studies produced on the subject of dynamic terrain, there are some approaches that take a simpler mesh-based stance, whereas some use a more complex particle representation. However there is also the potential to use a combination of these two methods, to produce a model that presents a good approximation of shifting terrain around and leaving depressions in the ground, while still being efficient enough with resources to make it applicable for real-time applications such as games (Prautzsch et al., 2009). This model may therefore prove to be an invaluable study when considering how best to implement the terrain deformation in this project in order to achieve the aims.

Project Plan

The plan for this project comprises of the following Gantt chart, with the associated tasks being detailed beneath the chart. The milestones of key points throughout the course of the project have been highlighted in bold.



Week 0: 26th October 2017 | Week 25: 26th April 2018

- Task 1: Research existing literature in the subject domain, making notes of their relevance and consider how their findings could be used to shape this project. This will be an ongoing process throughout this project.
- Task 2: Investigate the existing physics and game engines available for use, making selections appropriate for this project.
- Task 3: To experiment with the chosen physics and game engines to see what their feature set is.
- Task 4: To draft designs and prototypes for how the game could play and function, consider how dynamic terrain could be used in a unique way to solve puzzles
- Task 5: To refine these concepts to produce a definitive design document that will lay out the functionality the game should have, how it should play and how it should be presented,
- **Milestone 1: Have a completed design document for the game, highlighting how the game should look, play and behave. The physics and game engines to be used should also be selected.**
- Task 6: Develop the game, using the previously chosen physics and games engines, according to the specifications laid out in the game's design document
- Task 7: Test out the state of the game and make any necessary tweaks along the way, keeping track of these and noting why they may have been required
- **Milestone 2: The development of the game should be complete, ready to be presented to a selection of players to test it**
- Task 8: To consider the information required from the user testing phase, write up a post-test questionnaire and a consent form for the play-testers
- Task 9: Put a call out for people who would be willing to play-test the game from this project and answer a few questions about their experience with it.
- Task 10: Carry out the play testing phase, allotting time for all the previously sourced play-testers to try out the game, retrieve a log of their play sessions and ask them questions about their experience.
- Task 11: Compile the results of the user testing phase and evaluate their experience
- Task 12: Write up the project report. The continual, overlapping nature of this task demonstrates that this will be an ongoing process throughout the project, with small additions and alterations being made throughout.
- **Milestone 3: The project should be fully completed by this point**

The milestones, denoted by the blue bars, also comprise the slack weeks available in this project, totaling 3 weeks of available time should any of the tasks require it.

Risks

As with all projects, there are the typical generic risks with regards to personal issues arising and data being lost, these are not factored into the following break-down, but the necessary precautions will be taken to mitigate them. For instance, all data regarding the project will be backed up on multiple devices and stored in an online service continually to ensure no loss of work.

Green = Low Risk (1% - 35%)

Yellow = Moderate Risk (36% - 70%)

Red = High Risk (71% - 100%)

Risk	Likelihood (1 = Not Likely 10 = Very Likely)	Impact (1 = Minimal Impact 10 = Severe Impact)	Risk Quotient	Mitigation
The testers will be unfamiliar with the game and may therefore be confused and unable to play it	7	7	49	When the players are introduced to the game they will be presented with a document to explain the mechanics of the game, the controls and what their goal is. They are also free to ask any questions should they arise
It may be challenging to conceptualise suitable puzzles to make use of the game mechanics	6	8	48	The designing and prototyping phase has been allotted a reasonably substantial time-frame to ensure that ideas can be fleshed out and built upon to ensure a polished concept.
Implementing the terrain deformation mechanically could be challenging than anticipated	6	7	42	This concept of physics simulation will be investigated before implementation to ensure a concrete knowledge. Appropriate time has also been allocated to this component of the project, ensuring that any issues ran into can be worked through.
The physics engine may be difficult to implement into an appropriate game engine	6	7	42	Appropriate time has been allocated in the project to ensure that the available physics and game engines have been investigated, thereby allowing time to ensure they can be used in conjunction appropriately.

A lack of familiarity with the software may make implementation challenging	4	9	36	Should any issues arise, and before this, the associated documentation for the software will be sought out and referred to.
The design document for the game may specify components that are not possible with the chosen physics or game engine	4	9	36	The design document will be produced while referring to the physics and game engines' documentation, ensuring that the necessary components can be implemented.
A lack of familiarity with the software may make implementation challenging	4	9	36	Should any issues arise, and before this, the associated documentation for the software will be sought out and referred to.
Due to unforeseen issues with individual testers, the play-test phase may take longer than anticipated	5	7	35	Additional time has been accounted for in the project plan should any tasks overrun, so any necessary time can be taken here.
May not be able to find enough people available for the user testing component	4	8	32	Searching for people to participate in the play-testing stage will take place well in advance to allow plenty of time to find enough participants

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Ethical Approval Form: Library/Desk/Lab/Studio-based Research Projects

This form must be completed for each piece of research activity whether conducted by academic staff, research staff, graduate students or undergraduates. Applications by students must be endorsed by an academic member of staff acting as Principal Investigator/supervisor. The completed form must be sent to the designated Ethics Committee within the Faculty.

Please complete all sections. If a section is not applicable, write N/A.

1 Name of Applicant	Ashley Cromack
2 School or Department	School of Computer Science
3 Position in the University	Undergraduate
4 Role in relation to this research	Primary Researcher
5 Name(s) of collaborators/co-workers and their relationship to the project (e.g. supervisor, assistant etc.)	<i>Name, and role in project:</i> 1.Grzegorz Cielniak – Supervisor 2. 3. 4. 5.
6 Brief statement of main Research Question or Project Title	Investigating dynamic terrain as a novel mechanic to solve puzzles in games within a real-time physics simulation context
7 Ethical checklist	<p>Does the research involve living human participants, or human tissue? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If you answered “yes”, submit form EA2 for Ethical Approval.</i></p> <p>Does the research involve living animals, or animal tissue? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If you answered “yes”, submit form EA3 for Ethical Approval.</i></p> <p>Does the research involve confidential data, or data not in the public domain? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Does the project potentially put you or your collaborators at physical or psychological risk? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Could the topic or results of this research be seen as illegal, or attract legal action against the University from an outside agency? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Could the topic or results of this research attract unwelcome media attention, or affect the reputation or standing of the University? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Could the topic, results or conduct of this research be regarded as offensive, immoral or destructive by some reasonable people? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Does this research need to be undertaken under a relevant professional code of conduct? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Are there any potential conflicts of interest in conducting this research, including financial gain for the researchers, or for individuals or external organizations affiliated with the researchers? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Are there any factors inhibiting the application of the University's ethical guidelines, including those on proper treatment of data, research design and publication of results? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p>Does the research require the approval of any external body? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <p><i>If the answer to all questions above is “No”, you may complete section 8 to certify that there are no ethical issues, submit this form to the relevant Ethics Committee, and proceed with the research immediately. You accept professional responsibility for this decision, and if unsure should instead submit to the Committee.</i></p> <p><i>If the answer to any of the above questions is “Yes”, complete the rest of the form, submit to the relevant Ethics Committee, and await approval before proceeding with the research. Answering “Yes” does not necessarily imply that the research is problematic, only the Ethics Committee needs to consider the research to ensure that it can proceed, and that the research design conforms to best practice.</i></p>

8 Self certification of Ethical Review	<p><i>Having reviewed the ethical implications of this research, I certify that there are no issues requiring Ethical Approval. I certify that the research will be carried out in compliance with the University's ethical guidelines for library/desk/laboratory/studio-based research, with Health and Safety regulations, and with all other relevant University policies and procedures. If there are any changes to the research requiring ethical clearance, I shall apply for such clearance before continuing with the research.</i></p> <p>Signed:</p> <p>Principal Investigator</p> <p>Note. This section must be endorsed by the member of academic staff responsible for the project. In the case of research by students, the supervising member of academic staff must sign. The signed form should then be submitted to the relevant Ethics Committee within the Faculty, and the research may proceed.</p>
9 Does the research comply with the University's key ethical principles for library/desk/lab/studio-based research ?	<p>Yes <input checked="" type="checkbox"/> No <input type="checkbox"/></p> <hr/> <p>If "No", provide an ethical justification for your project and explain why you wish to continue with the research in breach of normal ethical principles:-</p>
10 If applicable, please state the relevant professional code(s) under which the research is being conducted and confirm compliance	
11 Does this research require the approval of an external body ?	<p>Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p> <hr/> <p>If "Yes", please state which body:-</p>
12 Has ethical approval already been obtained from that body ?	<p>Yes <input type="checkbox"/> -Please append documentary evidence to this form. No <input type="checkbox"/></p> <p>If "No", please state why not:-</p> <p>Please note that any such approvals must be obtained and documented before the project begins.</p>
13 If there are any other ethical issues, to which the attention of the approving committee should be drawn, please state them in this section, and explain how you have taken the issues into account, so that the research should be approved. Please consult the University's ethical guidelines for advice.	
Please also include here, or attach separately, a brief description of the research, to allow the approving committee to reach judgement.	

APPLICANT SIGNATURE

I hereby request ethical approval for the research as described above.

I certify that I have read the University's ethical guidelines for library/desk/laboratory/studio-based research.



Applicant Signature

25/10/2017

Date

ASHLEY CROMACK

PRINT NAME

FOR COMPLETION BY THE DESIGNATED FACULTY AUTHORITY

Please select ONE of A, B, C or D below:

☐ A. The Faculty gives ethical approval to this research.

☐ B. The Faculty gives conditional ethical approval to this research.

10 Please state the condition (inc.
date by which condition must be
satisfied if applicable)

☐ C. The Faculty cannot give ethical approval to this research but refers the application to the University Research Ethics Committee for higher level consideration.

11 Please state the reason

☐ D. The Faculty cannot give ethical approval to this research and recommends that the research should not proceed.

12 Please state the reason, bearing in
mind the University's ethical
framework, including the primary
concern for Academic Freedom.

Signature of Designated Faculty Authority for Research Ethics

Signature

Date

Key ethical guidelines for library/desk/laboratory/studio-based research

The University of Lincoln has drawn up the following key principles for researchers engaged in library/desk/laboratory/studio-based projects in order to promote high professional standards. They should be read alongside the University's Ethical Principles for Conducting Research with Humans and Other Animals, and operate as part of the University's Ethical Framework.

- Non-falsification of data: Researchers have an ethical obligation to refrain from tampering with data. Thus questionnaire responses, experimental observations and data analyses should not be fabricated, altered nor discarded. In addition, researchers have a responsibility to exercise reasonable care in processing data to ensure no errors affect the results.
- Ethics of reporting research: Researchers are obliged to give full and proper attribution of ideas: presenting the words, data or ideas of another person as your own without properly citing them amounts to plagiarism. This is not only misconduct but can also be an infringement of copyright, amounting to theft of intellectual property.
- Ethics and research design: Researchers should be open to a range of methods: failure to consider and evaluate alternative methods and tools for the collection of data may be regarded as too overtly biased. All appropriate steps should be taken to ensure that no samples are obtained from unethical sources e.g. illegal databases; unregistered suppliers of samples from humans or other animals.
- Authorship credit: Only those researchers who are significant contributors to a research project should be given authorship credit. A "significant contributor" might be described as a person playing a major role in conceptualising, analysing or writing the final document. Ideally, all those involved in the research project should decide upon the order of authorship. Usually, the first author is the one who has made the biggest contribution.
- Conflict of interest: Researchers should be aware of the potential influence of personal or commercial interests on their work and take all practical measures to ensure that information is presented without distortion.
- The principle of beneficence: Researchers are required to protect individuals by seeking to maximise anticipated benefits and minimise possible harms. It is therefore necessary to examine carefully the design of the study and its risks and benefits including, in some cases, identifying alternative ways of obtaining the benefits sought from the research. Research risks must always be justified by the expected benefits of research.
- Professional codes: Researchers should undertake research legally and in accordance with any relevant professional codes of conduct.
- Personal information: Researchers should anonymise information which relates to individuals when they have not obtained informed consent, unless there is a clear justification to the contrary. They should also be aware of the impact of wider public dissemination of their work and the impact this might have on any individual or group of individuals. If it is anticipated that it might cause distress, it is essential to demonstrate that the benefits outweigh this risk.

Ethical Approval Form: Human Research Projects

Please word-process this form, handwritten applications will not be accepted



This form must be completed for each piece of research activity whether conducted by academic staff, research staff, graduate students or undergraduates. The completed form must be approved by the designated authority within the Faculty.

Please complete all sections. If a section is not applicable, write N/A.

1 Name of Applicant	Ashley Cromack	
	Department: Games Computing	Faculty: School of Computer Science
2 Position in the University	Undergraduate	
3 Role in relation to this research	Primary Researcher	
4 Brief statement of main Research Question	Investigating dynamic terrain as a novel mechanic to solve puzzles in games within a real-time physics simulation context	
5 Brief Description of Project	The project is to develop a game that uses dynamic terrain as the focal mechanic to solve puzzles, using a real-time physics engine implementation to model this deformation. After the game is developed, the impact that this mechanic has on players and how they approach the game will be evaluated with a play-testing stage using volunteer testers.	
	Approximate Start Date: 30/10/2017	Approximate End Date: 26/04/2018
6 Name of Principal Investigator or Supervisor	Grzegorz Cielniak	
	Email address: GCielniak@lincoln.ac.uk	Telephone: 01522 837398
7 Names of other researchers or student investigators involved	1. 2. 3. 4.	
8 Location(s) at which project is to be carried out	University of Lincoln	

9 Statement of the ethical issues involved and how they are to be addressed –including a risk assessment of the project based on the vulnerability of participants, the extent to which it is likely to be harmful and whether there will be significant discomfort.

(This will normally cover such issues as whether the risks/adverse effects associated with the project have been dealt with and whether the benefits of research outweigh the risks)

Due to the play-testing section of this project, human test subjects will be required to participate. As such, the following issues are raised:

People may not be comfortable being involved in the play-testing

- To avoid this, people will not be coerced into being involved with this project against their will, only actively willing and consenting subjects will be involved in the play-testing stage of this project.

In the play-test stage, people involved may not feel comfortable with having their play-data logged or being asked questions on their experience

- To address this, an information sheet and consent form will be produced for the participants of this portion of the project. These documents will inform the testers of what the project is about, what data will be collected from their play session and will brief them on the types of questions they will be asked after their participation. If they're happy with the process, they can sign the consent form to verify this, otherwise they will not be subjected to this stage of the project.
- In addition, all the data tied to their individual play sessions will be anonymised and its scope will be tied to this specific project, which will be clearly communicated to the testers.

Ethical Approval From Other Bodies

10 Does this research require the approval of an external body ?

Yes ☐ No ☒

If "Yes", please state which body:-

11 Has ethical approval already been obtained from that body ?

Yes ☐ Please append documentary evidence to this form.

No ☐

If "No", please state why not:-

Please note that any such approvals must be obtained and documented before the project begins.

APPLICANT SIGNATURE

I hereby request ethical approval for the research as described above.

I certify that I have read the University's ETHICAL PRINCIPLES FOR CONDUCTING RESEARCH WITH HUMANS AND OTHER ANIMALS.

Ashley Cromack

Applicant Signature

25/10/2017

Date

ASHLEY CROMACK

PRINT NAME

FOR COMPLETION BY THE CHAIR OF THE FACULTY RESEARCH COMMITTEE

Please select ONE of A, B, C or D below:

☐ A. The Faculty Research Committee gives ethical approval to this research.

☐ B. The Faculty Research Committee gives conditional ethical approval to this research.

12 Please state the condition (inc. date by which condition must be satisfied if applicable)

☐ C. The Faculty Research Committee cannot give ethical approval to this research but refers the application to the University Research Ethics Committee for higher level consideration.

13 Please state the reason

☐ D. The Faculty Research Committee cannot give ethical approval to this research and recommends that the research should not proceed.

14 Please state the reason

Signature of Chair of Faculty Research Committee (or nominee)

Signed

Date