

Research on the Use of a Simulated Environment to Demonstrate the Transmission of COVID-19

Interim Report

DT211C

BSc in Computer Science (Infrastructure)

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Abstract

As the number of coronavirus infections continue to grow worldwide,

Declaration

I hereby declare that the work described in this dissertation is, except where otherwise stated, entirely my own work and has not been submitted as an exercise for a degree at this or any other university.

Signed:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Kyle Heffernan

Date: 14/12/2020

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I would like to thank my supervisor Bryan Duggan for his constant support and guidance throughout this project.

Table of Contents

[1. Introduction 7](#_Toc21978017)

[1.1. Project Background 7](#_Toc21978018)

[1.2. Project Description 7](#_Toc21978019)

[1.3. Project Aims and Objectives 7](#_Toc21978020)

[1.4. Project Scope 7](#_Toc21978021)

[1.5. Thesis Roadmap 7](#_Toc21978022)

[2. Literature Review 8](#_Toc21978023)

[2.1. Introduction 8](#_Toc21978024)

[2.2. Alternative Existing Solutions to Your Problem 8](#_Toc21978025)

[2.3. Technologies you’ve researched 8](#_Toc21978026)

[2.4. Other Research you’ve done 8](#_Toc21978027)

[2.5. Existing Final Year Projects 8](#_Toc21978028)

[2.6. Conclusions 8](#_Toc21978029)

[3. Prototype Design 9](#_Toc21978030)

[3.1 Introduction 9](#_Toc21978031)

[3.2. Software Methodology 9](#_Toc21978032)

[3.3. Overview of System 9](#_Toc21978033)

[3.4. Front-End 9](#_Toc21978034)

[3.5. Middle-Tier 9](#_Toc21978035)

[3.6. Back-End 9](#_Toc21978036)

[3.7. Conclusions 9](#_Toc21978037)

[4. Prototype Development 10](#_Toc21978038)

[4.1. Introduction 10](#_Toc21978039)

[4.2. Prototype Development 10](#_Toc21978040)

[4.3. Front-End 10](#_Toc21978041)

[4.4. Middle-Tier 10](#_Toc21978042)

[4.5. Back-End 10](#_Toc21978043)

[4.6. Conclusions 10](#_Toc21978044)

[5. Testing and Evaluation 11](#_Toc21978045)

[5.1. Introduction 11](#_Toc21978046)

[5.2. Plan for Testing 11](#_Toc21978047)

[5.3. Plan for Evaluation 11](#_Toc21978048)

[5.4. Conclusions 11](#_Toc21978049)

[6. Issues and Future Work 12](#_Toc21978050)

[6.1. Introduction 12](#_Toc21978051)

[6.2. Issues and Risks 12](#_Toc21978052)

[6.3. Plans and Future Work 12](#_Toc21978053)

[6.3.1. GANTT Chart 12](#_Toc21978054)

[Bibliography 13](#_Toc21978055)

# 1. Introduction

## Project Background

The purpose of this project was to design a simulation of the transmission of COVID-19 between people in a populated environment. As Coronavirus became a sizeable factor of everyday life for most people[x], I wanted to make a simulation to assist in visualizing how easily it can be spread in a populated environment.[x] I believe it will be beneficial for greater understanding of the transmission of COVID-19, as observing it spreading in real time will highlight the severity of the virus in everyday conditions.

## Project Description

## The Project includes simulated environments of populated buildings, such as a restaurant or office. There are autonomous agents walking around the buildings representing people going about their daily lives. The building has a navigation mesh to aid the agents[x], and they path find through this mesh, doing random tasks and having various interactions based on their role/job. Some agents are infected with coronavirus, so as they walk around, they breath/cough/sneeze intermittently creating a particle system from their mouths dispersing outwards.

## The particles in this particle system[x] have a chance of being infected, and if they are, they expose whatever they come in contact with to the virus. If they encounter a surface, it becomes contaminated with the chance of contaminating other agents. If the particles come in contact with another agent, there is a chance they will be exposed to the virus as well.

## The maths for the chance of particles being infected, how long they stay on surfaces and the chance of another agent getting exposed to the virus are all taken from medical papers[x]

There is a graphical user interface, allowing the user to alter numerous factors that affect the results of the simulation.

Factors the user can change:

## **Viral Load:** The number of particles coming from the particle system that carry the infection.

## **Masks:** Reduce the number of particles coming from each agent.

## **Number of Infected Agents**: The number of agents infected at the start of the simulation.

* **Susceptibility Factors:** Factors such as vaccinations, age, vitamin deficiencies, etc.
* **Time scale:** The rate at which time passes in the simulation.

[photo of GUI design]

## Project Aims and Objectives

Below I have outlined the objectives of my project.

* **Real Time Simulation**

The user can watch the simulation run in real time and observe the virus spreading between agents.

* **Change Variables**

The user can adjust certain variables that alter the results of the simulation.

* **Utilize Unity’s Navigation Mesh System**

A navigation mesh is a data structure which helps agents path find through complicated spaces by returning a collection of walkable nodes. The autonomous agents in this simulation will be able to path find through the building with the help of the navigation mesh.

* **Autonomous Agents**

The agents follow certain behaviours as they path find throughout the building following various feasible paths.

* **Use Data from Medical Papers**

The methods of transmission and exposure will make use of statistics taken from medical papers/journals

* **Utilize Unity’s Entity Component System**

The entity component system is a new approach to designing Unity projects which entails using data orientate design rather than the usual object orientated approach. It makes use of the C# Job System and multithreading to optimize performance.

* **Display Results**

The user can see statistics about the number of agents exposed to the virus as the simulation runs.

* **Utilize Unity’s Particle System**

The infected agents will be emitting infected particles from their mouths with the use of Unity’s particle system.

## Project Scope

This project allows users to view a COVID-19 simulation in real time and alter certain variables to see how they affect the transmission results. The simulation is made using Unity, and the environment in which the simulation takes place in is a populated building with autonomous agents walking around. Navigation Mesh is used to map out the walkable paths for the agents throughout this environment. The agents have simple designs and basic AI allowing them to walk through the building performing appropriate tasks. Infected agents emit particles using Unity’s Particle System that leave a surface infected, or they expose other agents to the virus based on their susceptibility. The user can alter the time scale to speed up the simulation, and they can also adjust variables that affect the result of the simulation such as susceptibility factors.

## Thesis Roadmap

One sentence explaining what each of the following chapters is about.

# 2. Literature Review

**As least 4 pages, but as many as you like**

## 2.1. Introduction

In this chapter …

## 2.2. Alternative Existing Solutions to Your Problem

Software you’ve looked into

## 2.3. Technologies you’ve researched

Programming languages, operating systems, etc.

## 2.4. Other Research you’ve done

Domain specific research

## 2.5. Existing Final Year Projects

## 2.6. Conclusions

# 3. Prototype Design

**As least 6 pages, but as many as you like (but lots of diagrams, which count towards the page total).**

## 3.1 Introduction

## 3.2. Software Methodology

## 3.3. Overview of System

Include a diagram

## 3.4. Front-End

Including screen prototypes and Use Cases

## 3.5. Middle-Tier

## 3.6. Back-End

Including ERDs, and maybe ISDs

## 3.7. Conclusions

# 4. Prototype Development

**As least 2 pages, but as many as you like (but lots of code samples).**

## 4.1. Introduction

## 4.2. Prototype Development

## 4.3. Front-End

## 4.4. Middle-Tier

## 4.5. Back-End

## 4.6. Conclusions

# 5. Testing and Evaluation

**As least 2 pages, but as many as you like**

## 5.1. Introduction

## 5.2. Plan for Testing

## 5.3. Plan for Evaluation

## 5.4. Conclusions

# 6. Issues and Future Work

**As least 5 pages, but as many as you like**

## 6.1. Introduction

## 6.2. Issues and Risks

## 6.3. Plans and Future Work

### 6.3.1. GANTT Chart

# Bibliography