Department of Computer Science

Individual Project - CS3IP16

RenegadeSurvivor.co.uk - an online, text based, multiplayer game (MUD)

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Date of SUBMISSION

Abstract

Glossary of Terms and Abbreviations

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# Introduction

A MUD (multi user domain) [1] is a text based, interactive, online game. Multiple players can create characters and join a real-time virtual world. In it, they complete quests, role-play, fight other players and find AI characters to interact with. It’s a genre of gaming that has been around since the 1990s.

MUD worlds consist of a collection of interconnected rooms that form a virtual space. Players move between these rooms and traverse the world by typing commands with the keyboard. The world usually has a theme or setting which informs gameplay, characters and goals. Their purposes have been both educational and for the sake of entertainment.

So why MUDs? The simplicity of the interface makes them great spaces for imagination, diversity and quantity of content. In a graphical game, only worlds or gameplay that have been graphically produced can been shown. In a MUD however, the world is generated through imagination inspired by the text. This means that different MUDs can have the similar code and still be radically different in the expression of their worlds. In one, player’s might throw fireballs, in the other they might fire arrows, in another they might fire a gun. The code would look very similar; get strings from client to server and vice versa. The player’s experience would be radically different.

An educational MUD called ‘Diversity University’ [2] was created in 1993 by Jeanne McWhorter. Players could access a virtual university and even attend lectures and classes that were ‘held’ in its virtual world. Students even created Dante’s Inferno [3] inside the MUD to learn about it.

Complex human interaction and systems can be produced by the community of players in ways that graphical games cannot replicate. An example of this is Achaea [4] a MUD that has six player run cities with their own councils, governments, ministries and cultures. The social interaction that this game allows players to engage is only possible because the medium allows such freedom.

Freedom of imagination is the strength of all MUDs, the freedom to create the virtual world in the minds of the players.

From Mume [5] which represents Tolkien’s Middle Earth, to Discworld Mud [6] which depicts Terry Pratchett’s Discworld, to the many other virtual worlds [7] [8] [9] [10] created in MUDs, the complexity, detail and size of the worlds is phenomenal. Players can explore, socialise, build and archive to a serious degree of immersion and detail. From complex AI interaction to player run city states to educational literary works, the freedom with which MUDs can express virtual worlds is great.

However, MUDs have some common limitations, which inhibit that freedom of imagination and constrain a player’s sense of immersion in the virtual world, their sense of ‘being there’.

RenegadeSurvivor.co.uk has been built with the sole purpose of overcoming one of these limitations.

# Problem Articulation / Technical Specification

This problem is that in MUDs, the interactivity between rooms is severely limited. When one player is in one room, they have absolutely no indication of what is going on in another room.

Sometimes this makes sense. If the rooms are supposedly miles apart in the virtual world then players shouldn’t know what’s going on in the other room. But at other times it makes no sense at all. What if the rooms were adjacent, separated only by a plasterboard wall? A player in room A wouldn’t be able to see into room B, but they might be able to hear what’s going on. What if the wall had a window? A player could see into room B from room A but not access it. The lack of interactivity between rooms limits a worlds sense of reality.

The people who are affected by this problem are the players and the world builders. The players are affected because their sense of being in the world is limited. World builders are affected by this because the worlds they can create are limited to a series of connected capsules.

One example of this, is in Achaea [4]. A player can become a dragon when they reach a certain level. This is a very exciting feature. This means that in one room a dragon can be fighting a horde of AI agents in the world with its fire and claws. If another player were in an adjacent room, surely, they would see the battle going on, hear its roars, smell its fire. But that’s not the case. Their only indication that something is going on is that another player is in the room because of the map. Player’s abilities to sense the world around them is constrained. Their imaginations are only ever informed that they need to render the game, at the point of entering a room.

Another example, is in Mume [5]. Players can aspire to become wizards of great power. The level of their spells increases as they level up which means at high levels their spells can be very impressive. Imagine there was a fire storm spell that created a fierce storm of flames. In terms of a player’s imagination, that spell’s description would really fire the motors of their mind, painting an elaborate picture of them using the spell. That picture is somewhat tainted when the effects of such a spell are limited to one room. The spell might conjure a tornado of fire thirty feet wide and as hot as volcano, but if it only effects the small wooden shed the player casts it in, the sense of grandeur is somewhat deadened, especially if the wooden walls of the shed survive the scorching. All that power and it couldn’t even breach the walls of a wooden shed.

In terms of educational uses, a space where learners can watch each other learning is very important. Let’s imagine an educational MUD like Diversity University [2]. If players were learning how to undertake some task, let’s say build a motor engine, watching other player’s progress is a part of that learning. One player might already have an engine running in one room, but an ‘instructor’ play can’t hear it they will never know unless they check on that room.

The following criteria has been written to validate whether this problem has been solved by a proposed solution.

1. Players should have a range of senses which they can use to detect the ongoing action in other rooms. Whether they can sense something in other rooms should be determined by distance from the room, the world and the strength of the action being sensed.
2. The MUD framework should allow world builders enough freedom to create rooms that allow and block these senses to varying degrees, regardless of the flavour of theme of the world.
3. Players should have commands available to them which have cross-room impacts. When they perform such actions, the consequences should be felt across the other rooms, changing a rooms state or effecting detectability.
4. Players should be able to interact with the objects in the world in such a way that the objects impact their likelihood of being detected by other characters. These should both increase and decrease their detectability.

The vision is that a solution would provide techniques or a framework by which the interactivity between rooms can be increased. Where before a player could not detect the raging battle going on ahead in their world until it is too late, a solution would give them means of doing so, enhancing the freedom of their imagination. They might rush in a join the fight, they might hide in the shadows and pick off assailants from cover. Where before world builders were limited to creating a connected world of capsules, a solution would break down the walls between these capsules, meaning more object properties can be simulated, allowing for objects such as windows or thin walls.

# Literature Review

Surrounding the question of how such a system might be implemented, lies a few core factors. Each factor is evaluated below along with the potential technologies that could be used in the final implementation.

## Delivery

The question of how a player gains access to the MUD is very important when considering the problem. The wrong kind of method of delivery will affect the limitations on how cross-room interaction can be implemented. Options were considered by researching existing MUDs.

### Flash Client

Some MUDs such as Aardwolf [9] use flash clients. This means that on the play page of the website the game runs in one flash content section. Flash is a mature technology and there are some drawbacks and showstoppers when considering its usefulness in solving the problem. The main one is longevity. The number of websites using flash is going down [11]. Why use a declining technology? In an article by Apple’s former CEO Steve Jobs [12] highlighted his reservations about flash and how Apple does not support flash on their smaller devices.

### Telnet

Telnet is a mature internet protocol which users can use on UNIX systems to access remote networks and machines [13]. Legendsofkallisti [14] is a MUD which supports this method of delivery. The problem with Telnet is that has no graphic or colour support [15]. While for a MUD server it is not a disaster because the main interface is an input box with a larger output text section, for cross-room interaction it’s a big issue. If all content is limited to the output box there is no way of displaying a map or having other sections to display what might be occurring in other rooms.

### MUD Client

Mume [5] and many other MUDs use MUD clients. These are programs that players install onto their machines that allow them to access a variety of MUDs. The player enters the web address and port and then the software handles the connection. However, these are really just glorified telnet programs [16]. They may have certain MUD tailored features, but the technology is the same. In terms of cross-room interaction the ability to make headway is limited by the technology and features of each MUD client.

### Web Client

Most MUDs running today use a web client such as Achaea [4] and Forgotten Kingdoms [8]. A player accesses the website, creates a character and is then redirected to a play page within their browser. The play page is just a webpage and therefore can support other content around the main game interface. This is by far the best delivery method in terms of player effort. The system handles all the client server configuration on the site. In terms of influencing the cross-room interaction problem this option gives the most freedom to display additional information to players relating to other rooms.

## Connecting Players

The different delivery options create certain question regarding how players connect to each other. For telnet and MUD clients this is already handled by the delivery method. For flash and web clients and solution to how players connect to the server is required. When one player leaves a room on their client, another player’s client needs to receive that information from the server and update accordingly. To solve this, three solutions were considered.

### Socket.io

Socket.io [17] is real time engine that supports client-server connections. Its main advantage over technologies such as AJAX is that it removes long-polling [18] which means sending HTTP data requests regularly. It provides a server and client API which allows connections to a server to be managed. In terms of enabling a web client of flash client this technology provides a means for players to connect to the host server within their browsers. Both clients and server can emit event between each other allowing for the creation of one consistent world.

### Pusher

Pusher [19] performs the same function as Socket.io. It provides an API a triangular architecture [20] where the whenever the server emits a message, it uses the Pusher API to send it to Pusher. Pusher uses WebSockets to update client browsers. Client browsers use existing HTTP to update the server. Its purpose in this project would be to provide the vehicle by which a consistent world can be created through client server connections for web clients and flash clients.

### HTML5 Custom WebSocket Solution

Another solution would be to write custom server client software that utilises WebSockets [21]. This would mean writing a TCP application in a server-side language to handle client’s connections to the server. The main downside to this approach is that while it gives freedom to the developer of the project in terms of how connections are managed, that freedom is meaningless in terms of cross-room interaction in MUDs. It doesn’t matter how the data gets from sever to client and back. What matters is how the data is handled when it arrives.

## Updating Client Content

Therefore, for web clients, the question of how to update the clients content within the browser is raised. When the data is sent to the client, how the browser displays the data in real time must be answered. For example, it would be unacceptable to reload the browser every time it receives from the server. To solve this issue for web clients, two JavaScript frameworks were reviewed.

Both are used to make single page web apps. This means all content is loaded onto one page and updated dynamically [22]. When one part is accessed by a user, only the content for that part is loaded, meaning no page refresh, because there is only one page.

### Angular 4

Angular 4 [23] has more features. These include dependency injection, templates, routing, forms, component CSS encapsulation, XSS protection and utilities for unit-testing components [24]. In terms of creating an interface that can deal displaying a UI that informs the user of their characters senses the strong component model provides a good choice.

### ReactJS

ReactJS [25] has a weaker component model and less features [24]. This means there is greater flexibility in development because more code must be written alongside it, but also more effort.

## Running the Game

To run the game, the server must execute the game code continually. For mud clients and telnet clients, this means connecting to the program port on the server, where the program is running. The telnet/mud connection handles the handshake and allows the client to interact with the game code already running. For web clients the browser sends a HTTP request to the port on the server machine to form a connection. The server machine runs code that manages the client to server connection. Similarly, the player connects to the server’s port where the game is running.

Two options were investigated when looking into how to run the game on the server.

### NodeJS and PM2

The first was NodeJs [26]. NodeJs runs JavaScript. It has an extensive library of packages that it can call and run. One of these is PM2 [27]. PM2 is a production process manager for Node which continually runs JavaScript code. When there is an issue or a drop out it restarts the JavaScript so that it runs continually. The usages of this in MUDs lie in the running of the game.

### MUD Runner Software

The second option was to use a pre-existing MUD runner [28]. This would mean using a prebuilt software to run the game. One of these is called CircleMUD [29] a system written by Jeremy Elson. This would mean that a lot of the MUD ground work will have already been written and therefore save time.

## Path Finding

The problem of characters having senses that detect things in other rooms requires a path finding algorithm. Whether a character can hear a sound in another room for example, depends on several factors, such as loudness, distance and anything blocking the path between origin and receiver. Whether or not the sound can be detected might depend on its loudness versus the distance of the path back to the hearer.

### Dijkstra’s Algorithm

Dijkstra’s shortest path algorithm [29] runs on a weighted graph. It starts with an initial node and goal node and finds the shortest path between them. It uses a visited set and an unvisited set. Every node has a value that defines how long it took to reach that node. These values are initially set to infinity but as the algorithm progresses they are updated with the lowest possible value. This gives a selection of lowest paths each with an overall value at every stage of the algorithm. When there are no more nodes on the unvisited list, the lowest value path is chosen. Therefore, it always provides the best solution.

### A\* Search Algorithm

A\* search algorithm [30] is a form of Dijkstra’s algorithm but improves it by using a heuristic. The heuristic could be Euclidean distance, Manhattan distance, Chebyshev distance or any other. The function is:

G(n) is the value of the route between two nodes and h(n) is the heuristic that estimates the overall cost of the node to the goal node. This means that where Dijkstra’s algorithm will check all possibilities, A\* search eliminates paths from consideration based on the heuristic.

# The Solution Approach

The problem is that cross-room interactivity in MUDs is severely limited. A solution needs to provide players with a range of cross-room senses, commands and object interactions and world builders with tools to allow their worlds to make this possible.

## Browser or telnet delivery

When looking at the options two branches appear very early on regarding delivery. Should players connect using telnet or in a browser? These are compared in the following table.

|  |  |  |
| --- | --- | --- |
| Client Solution | Advantages | Disadvantages |
| Telnet  *(mud client or telnet)* | It solves a lot of problems in terms of connecting players and how the game is displayed to a player.  MUD Clients already exist so time can be saved in development. | There is only one space given to the player, one text input and output. Questions such as how to properly display senses are raised. |
| Browser  *(flash or web client)* | The web page on which the game runs provides space to give the user additional information. | More development effort is required to build the framework by which the game will be delivered. Questions such as how to connect players or update connect on the page are raised. |

When comparing these options each solution raises issues. The most pertinent of these are seen in the disadvantages column.

Firstly, how can a telnet solution provide enough interface to display senses without overload? Should text be displayed that informs the user what they are sensing in other rooms? Surely the amount of data would overload the player. Line after line of text displaying other room data would detract from the experience within the current room. If a player is fighting in their current room, then most of the time they don’t care about a vague sound two rooms away. Using line after line to display that information would destroy the experience in the current room. However, if for some reason they do care about the ongoing in another room, maybe for game related reasons, maybe a target is escaping, then they need that information. In short, they need to be given the tools to choose to sense in other rooms.

But the only tool that telnet could offer would be a command to sense, for example a listen command. The issue with this is that our own human senses are not triggered by commands, they are always functioning. We can block out or miss some senses when another sense overpowers, but we don’t turn them on an off like commands. The system needs to make it so that a player is always listening but based on relevance can block out data.

In direct contrast to telnet, using a browser can solve this problem. Around the input and output text, the focus of the player’s attention, additional information can be displayed. Thus, senses can be given to the player which are always there but can be ignored when the user deems them irreverent. The player would have the power to decide what is important by what they look at on the web page. If they are fighting in a room, they might miss data displayed on a map. Equally, they could deem that data important enough to check the sense data.

Therefore, telnet cannot solve the senses issue in such a way that a browser delivered MUD can.

However, the second issue raised in the table is that while a browser-based delivery method solved the senses problem, it means that other problems need to be solved, such as connecting players and updating the web page content.

## Connecting players in browsers

Using browser delivery may solve the senses issue but it means a solution to how to connect players is required.

Three were analysed, Socket.io, Pusher and creating a custom solution using HTML 5 WebSockets. Very soon the latter was discounted because the prior two accomplish everything that needs to be accomplished and there’s no reason to reinvent the wheel. Also, the decision about how players are connected in browsers does not directly affect the problem of cross-room interaction. Both socket.io and pusher handle getting data from clients to the server and back again. All that matters is flexibility in tying in their solution to the MUD.

## Updating client content in browsers

Using browser delivery also means a solution for how to update a web page is required. Flash can update itself, so running the client using Flash player goes some way to solve this issue. But is does not go the whole way. For example, when talking about the senses issue, providing the player with a range of senses that doesn’t overload them means having information outside the main text box. Using Flash would mean that a solution would be required to comprehend what was happening inside the flash player and then feeding that back to the web page, which is a problem that is not worth solving. Instead a web client with a HTML text box is much better.

However, this means that a solution for updating content on the web page is required. Therefore, two single page web app frameworks were considered. These were ReactJS and Angular 4. They both solve the same problem, how to dynamically update web page content. There is not much between them, but one main factor is the component model. Angular 4 has a strong component model [24] which means that pieces of content can componentised and the reused. For displaying additional senses information this is very important. If the player has hearing data in one component, sound data in another etc. during development or on user request, the locations of these on the page might change. Angular 4’s components can be easily moved on from one part of a web page to another. As the method of displaying senses data is crucial to the solving of the main problem, freedom to provide different layout is paramount.

## Running the game

The previous sections have looked at the running of the client. This section looks at the running of the server. Crucially, the vehicle for the running of the game needs to allow for greater cross-room interaction. Two aspects of the problem are important here. Firstly, the outworking of the results of commands that effect multiple rooms. Secondly, a framework that give world builders tools to create worlds that allow greater interaction with regards to senses and detection. The two options considered were NodeJS and using MUD runner software [28].

|  |  |  |
| --- | --- | --- |
| GAME RUNNER | advantages | disadvantages |
| NodeJS | There is complete freedom to create the core functionality to solve the problem using JavaScript.  Socket.io is installed via NodeJS so would require no extra code to connect it to the game. | MUD needs to be built completely from scratch, meaning less time to work on the world itself. |
| MUD RUNNer software | Much of the core functionality is already done meaning development effort can be focussed elsewhere. | The MUD may not be able to solve the problem. Core functionality may be restricted or limited to the norms of the MUD genre meaning cross-room interaction improvements cannot be built in. |

The crux of the issue is that while using NodeJs will be more effort, the problem can definitely be solved. Whereas using a MUD runner would being tied into design decisions that may affect whether the runner can support cross-room interaction to sufficient standards. One main bone of contention is what the room object contains and how modifiable it is. Finding a suitable enough MUD runner may not even be possible.

## The Solution

Therefore, with all these things considered the chosen approach will be as follows. The game will be run using NodeJS to give freedom to the solution during development. A web-based client will be used as a method for players to access the MUD so that a range of sense data can be displayed. This web-based client will connect to the server using Socket.io because socket.io runs on NodeJS. Updating the clients content will be managed by Angular 4 because of its strong component model [24] which gives it its flexibility in creating UI.

The criteria by which this solution will have succeeded is as follows:

1. The range of senses will be displayed on an angular 4 site that places sense data next to the main play interface. This will allow players to ‘sense’ cross-room activity.
2. The game runner will allow a world to be loaded that has means of blocking and allowing players to sense activity in other rooms based on terrain.
3. Players will be able to input commands that have cross-room impacts, changing other room’s states and effecting detectability.
4. Objects will allow players to hide in/under/behind them to affect their cross-room detectability.

# Implementation

## RenegadeSurvivor.co.uk

The premise. How its cross-room features will solve the problem.

## Design

Its design diagrams, classes, how each part functions.

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Backend and frontend technologies used. Classes and their purposes. Flow diagrams. Common use case diagrams.

FEATURES: Face direction, sight lines, sound detection, smell detection, interactive lighting, objects to hide in, explosions and time

# Testing: Verification and Validation

Manual testing and test cases. Important feature tests and reports.

# Discussion: Contribution and Reflection

Has it worked. Limitations. Lead on to future work.

# Social, Legal, Health & Safety and Ethical Issues

Words:

# Conclusion and Future Improvements

Words:

# References

|  |  |
| --- | --- |
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# Appendices