The Impact of Lag Compensation Techniques on Game Design and Player Experience

(Technical Topic)

Addressing Negative Social Interactions in Online Games

(STS Topic)

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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The Status Quo of Networked Games

Online gaming is a billion-dollar industry and will continue to grow for the foreseeable future. However, online game development is not an easy or inexpensive task. Costs can approach $50 million to develop and release a MMO (Massively Multiplayer Online) game and close to $500 million to maintain them (Morgan, 2009, p. 4). Meanwhile, developers must ensure that the player experience is rewarding and maintains interest long term by adapting their intended game mechanics, dynamics, and aesthetics to an online environment. In other words, a game's rules, systems, and entertainment value must be consistent regardless of it being played online or not.

One of the major variables introduced in an online environment that affects the player experience is network delay, as it can influence a player's inputs and reactions. In particular, games such as first-person shooters and sports games have among the "lowest tolerance in terms of delay" since players have direct control of their character (Beznosyk, 2011, p. 1). Cooperative games are also sensitive to network quality with delays beyond 100 ms and jitter higher than 50 ms being unacceptable (Beznosyk, 2011, p. 3). For "power gamers" or players that are "instrumental, focused, and goal-oriented in ways that often exceeded the bounds of the game", it is crucial for online games to have responsive inputs and consistency (Taylor, 2020, p. 111).

Another component that impacts the player experience in online games that should be acknowledged is the social aspect. When playing offline, players get to decide who they engage with. However, in online games, systems such as matchmaking often dictate who a player will encounter. Since gaming in social contexts has positive and negative effects, and these effects extend offline, developers should strive to minimize unpleasant social interactions in order to maximize the positive effects of playing online games (Fox, 2018).

Failing to develop an engaging online gameplay experience could dissuade players from playing online multiplayer games. In order for online games to maintain their popularity and profitability, game developers must continually discover optimal methods to compensate for networking issues as well as implement mechanisms to deter inappropriate behavior from players. For my technical project, I will be conducting an analysis of current strategies used to compensate for lag in online games as well as describe a plan of research that will investigate their impact on game design and the player experience. For my STS project, I will be conducting a literature review to assess the circumstances surrounding social interactions in online games.

The Impact of Lag Compensation Techniques on Game Design and Player Experience

Recently, there has been a strong push by gamers for developers to begin implementing better networking solutions in online games. Currently, developers utilize lag compensation techniques in an attempt to hide the effects of delay. The way in which lag compensation is achieved differs based on the network architecture a game is designed with. Online games are typically structured using two network architectures: the client-server model and the peer-to-peer model.

In the client-server model, the client, or the host machine, requests information from a server, or a remote computer that provides a resource or service. In response to the client's request, the server sends back a response message with the requested information. The diagram below illustrates this interaction between devices. For client-server games, client-side prediction, or predicting players' inputs to determine future game states rather than waiting for inputs to be received and processed, has been a staple implementation of lag compensation. However, this model is not the ideal solution for all games since it suffers from drawbacks such as

"deployment, operation, and maintenance costs, scalability, availability, and low fault tolerance (Neumann et.al, 2007, pp. 1)." Specifically, for games such as fighting games that are one-versus-one, the time needed to send data to the server can add delay unnecessarily.
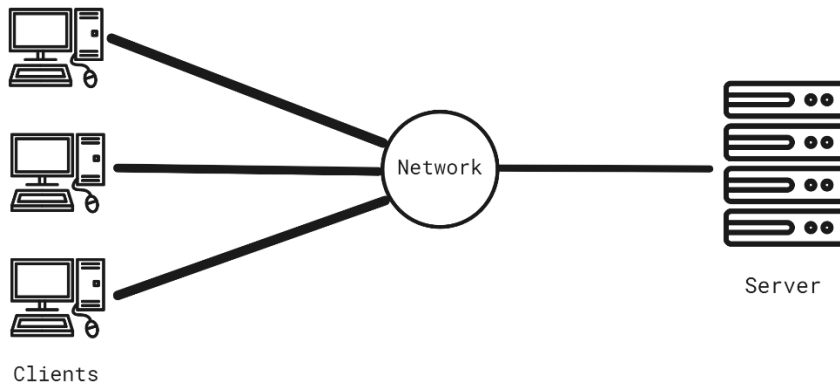
Figure 1: Client-Server Model: Each client (player) connects to a central server. The clients will send their inputs to the server and the server will send back a version of the game with the processed inputs. *(Created by author)*

For games where the client-server model is insufficient, the peer-to-peer model is used. In this model, individual clients to share messages between each other, removing the need for a dedicated server. An illustration of the peer-to-peer model is shown below. Developers of peer-to-peer games have been split as to how they implement lag compensation (Pusch, 2019). Many developers, especially in the west, have been improving the online gameplay experience by transitioning to rollback networking that utilizes similar principles to client-side prediction. Instead of waiting for user inputs to be sent and processed, the game does not wait for both players' inputs to advance. It predicts what the opponent will do based on his or her last input and corrects in the event of a misprediction (Pusch, 2019). The primary advantage to this is that networking issues are less likely to affect the quality of a game. The traditional solution to networking in peer-to-peer games is to rely on delay-based techniques. With this solution, the game will add delay to player inputs in the event that players are out of sync with each other

(Pusch, 2019). On connections with little latency, delay-based solutions work well and does not require much effort to implement.
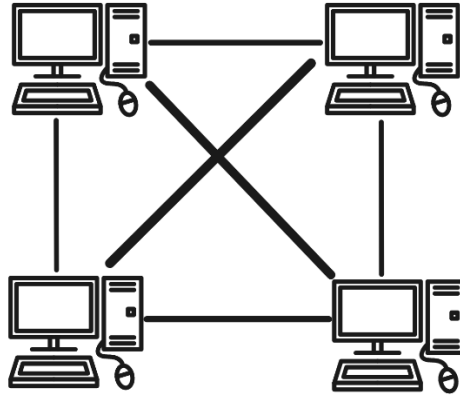
Figure 2: Peer-to-Peer Model: Each client (player) shares information with each other. *(Created by author)*

Since there is less consistency when it comes to implementing networking in peer-to-peer multiplayer games, my technical project will involve doing a further examination of lag compensation techniques currently used with that network architecture. This analysis will discuss the advantages and disadvantages of each technique and known implementations (that can be easily found). From this review, I will suggest how to potentially improve on the lag compensation techniques. Lastly and most importantly, I will propose future research that can be conducted to test the impact that this would have on the player experience and whether my suggested improvements would be an area of interest for developers.

Addressing Negative Social Interactions in Online Games

Although video games are often viewed purely as entertainment, they can be a social activity as well, and online games have contributed greatly to this. Through the growth of the Internet, networked games have enabled players to engage in vast multiplayer experiences

remotely with friends and strangers from many regions around the world. Games such as fighting games and real-time strategy games promote one-on-one competition. Some games such as first-person shooters and sports games focus more on the team-oriented competitive experience. Other genres such as online adventure games allow players to explore virtual worlds together and cooperate to complete objectives. All of the social dynamics presented thus far are what entices people to play online games (Fox, 2018).

However, similar to non-gaming settings, participating in online gaming sometimes entails dealing with undesirable and potentially dangerous social situations that taint the online gameplay experience. In a 2019 study, it was found that 74 percent of players have experienced some form of harassment from playing online games with 65 percent of players having experienced severe harassment (ADL, 2019). Many players indicated that skill disparagement, or mocking players due to a difference in skill level, and toxic masculinity, reinforcing traditional male gender roles, were common forms of negative communication endured when online (Fox, 2018). On a more serious note, players cited instances of actions such as stalking and physical threats. Others also reported being targeted due to race, religion, ability, gender, gender identity, sexual orientation, and ethnicity in addition to being exposed to extremist ideologies and hateful propaganda (ADL, 2019). This aggressive behavior has significant consequences that should be acknowledged. Some people will just dismiss the actions and continue to play. In some instances, players will reciprocate negative interactions initiated by other players, leading to a vicious cycle of hostility (Fox, 2018). Others may become demotivated from playing as engaging with the behavior is not worth the trouble, especially if the situation has implications outside of the game. An activity that is meant primarily to be a form of pleasure should not be subject to these issues. Lots of interesting content here. Not clear what claim it is supporting.

My approach to resolving this problem would be to explore how and why online games promote these negative social interactions using the Actor-Network Theory. Latour (1992) suggests that the rules that are established by technology promote certain behaviors that ultimately influence the decisions individuals make. In the case of online gaming, it seems to encourage the negative mindsets and actions that exist in non-gaming settings. Therefore, investigating the effects of the networking factors discussed previously as well as looking into other psychological and social factors could provide some context and insight that would explain why negative experiences occur. Based on Dyer (2009) requirements for innovation, this procedure is sensible as innovating necessitates associating unrelated factors, questioning existing practices, and observing others to find ways for improvement. In a manner similar to the one proposed by Neeley (2010), strategies can be devised that game developers and engineers could take to reduce the frequency at which uncomfortable scenarios happen after determining the relationships between the technical, psychological, and social factors and player behavior.

Intended Outcomes

By performing analysis and conducting research on the current networking approaches used in game design, it is possible to obtain a better understanding of the problems that plague them. With an improved understanding of how these techniques work, it will be easier to identify how they contribute to the issues observed by players in online games and begin crafting ways to work around them. Through investigating the various factors that contribute to unpleasant social interactions in online games, game designers and engineers will be more aware of the impact that their products have on consumers. Combining the work from these projects will provide developers with a more nuanced perspective of the online gaming experience, making it easier to create methods to grow and improving it.

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