CS486C – Senior Capstone Design in Computer Science
Project Description

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Project Title: Vaccine Games for Teens	
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Project Overview:

COVID-19 vaccination could play a critical role in improving the symptoms among people living with long COVID19, preventing COVID-19-related deaths, hospitalization and ending the pandemic situation. Despite these potential benefits, through October 12, 2022, approximately 8.5 million U.S. children aged 12-17 and 7.8 million children aged 5- 11 had not received the initial COVID-19 vaccine dose. For example, in the state of Arizona, over 60% of people under 20 years of age had not received even a single dose of the COVID-19 vaccine according to the Arizona Department of Health Services, and in Maricopa County, only around 10% of children aged 5-19 were up to date with the vaccine, with only 37% having received the primary series. Despite the clear need to promote vaccine uptake among children and adolescents and to minimize COVID-related morbidity and mortality, to date, there are no intervention studies underway aimed at improving COVID-19 vaccination rates among youth aged 11-14. Like COVID-19, HPV vaccination continues to be a dire problem with severe long term health risks associated with an HPV infection. According to the Center for Disease Control and Prevention, approximately 80 million Americans are currently infected by human papillomavirus (HPV). Ranking as the most common sexually transmitted infection, HPV prevalence continues to increase with an estimated 14 million new cases yearly. HPV is a family of viruses that infect both male and female epithelial tissue. Certain types of HPV have been significantly associated with various cancers and diseases including, cervical, vaginal, and vulvar cancers in women; penile cancers in men; and oropharyngeal and anal cancers in both men and women.

Designing games to help improve vaccination rates among teens is an exciting opportunity to improve health outcomes in our community. The task of this capstone project is motivated by a gap in the literature on the impact of teens' decision-making when situated in game-based environments that provide them with the ability to control decisions that impact the outcomes within the games. To increase the likelihood of success in improving vaccination rates, this capstone is situated in the context of clinics where teens and their parents (dyads) frequent and are waiting for their appointments. This limits the total interaction time (15 minutes or less) within the game and therefore the games have to be fast-paced, fun and at the same time provide a range of decision-making choices to fully engage the dyads in addressing the outcomes. To smoothly integrate video games and behavior change, it is suggested to the capstone team to design a framework that makes games to be of short duration which not only eases game development, but also analytics and maintenance. This framework, when combined with repetitive gameplay-based interaction, gives rise to the concept of burst games. Burst games are fast paced repetitive games that promote learning by doing while keeping the cost of failure to a minimum, thereby lowering frustration. They consist of quick "bursts" of game play instead of complex and long playthrough strategies, hence the name. Smaller problems require small play time per attempt, and therefore participants can immediately incorporate the feedback that they received in their next play-through. The capstone team is encouraged to apply this ideology when designing the game framework. A common example of a commercial burst game is angry birds, however my favorite game that follows this format is an old arcade game called puzzle fighter.

The technical task for the capstone team is to build a content agnostic game development framework that can be used to rapidly create games for different domains (Covid 19 vs HPV). This framework should apply principles of component-based design and architect the framework in a manner that other teams in the future could easily make

newer games with it. The components in the framework should extend the Unity's base/core components and it is not necessary to make completely new ones. The two games developed by the team over the course of the capstone would be example use cases of how to use the framework with minimal effort and maximum software reuse. The constraints that the framework would adhere to are the following:

1. Games are short and they are repetitive in nature.

2. They are played in a clinical sitting via a tablet on the web browser.

3. They have a specific behavior change outcome – in our case increasing vaccination rates.

4. They are targeting younger adults and have parental supervision (a dual person approach is critical in these settings).
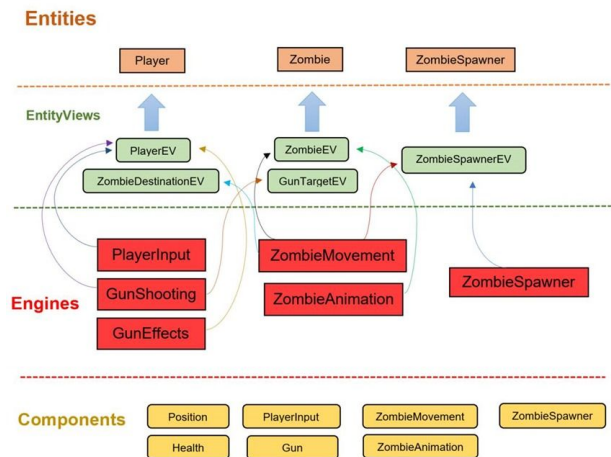
The above figure provides an overview of how the entity-component system in Unity operates. Your mission if you choose to accept this proposal is to extend this in a manner that satisfies the above four constraints.

Knowledge, skills, and expertise required for this project:

- Open-source software development, source control, merging, documenting and collaborating with code.
- C# programming with Unity development experience.
- Component oriented software architecture and design.
- Ability to break problems down into manageable software requirements and tasks.
- Agile development methodologies and working together in a team to build software applications.

Equipment Requirements:

- Any standard laptop that can run the Unity Engine.

Software and other Deliverables:

The team will have three major milestones and deliverables:
1. Architectural design framework that builds on top of the Unity Engine for rapidly developing vaccination promotion "Burst Games".
   a. A detailed design document that described the core features of the architecture and how the different components interact.
   b. UML diagram that shows the relationships of the code components.
   c. Two use cases that prototype developing a game with the above framework, one for covid 19 and another for HPV.
2. Two working games that are deployed to run on the web via a browser, preferably hosted on itch.io
3. Well documented code repository for the project that separates the game framework from the two games developed via the framework. Importance is given to software reuse and how the team leverages the common elements in the framework to keep the effort needed to make different domain games minimal.