

# EMERGENCY | EVAC

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## Goal and Objectives

The objective of this project is to create a multi-user game that felt like a city emergency which includes but is not limited to the emergency and medical staff. This means it has most of the core components that would be found in or around an inner-city such as skyscrapers, cars, buses, etc. This was also meant to be an AR game to make the user feel like a virtual city in an emergency were part of the real world. The actual game's goal is to apprehend the suspect and provide medical training to the injured victim(s) while in the middle of a busy city.

The target audience is gamers, first responders men and women, and people who love VR apps. The game was made to allow users to have simulations and feel like everything and everyone can participate in the game. To accomplish this, I used Photon Unity Networking, Unity3D, and C# development.

## Implementation

This section will discuss the process of implementing the training module. The module was created through 3 different phases. The phases were the Modeling phase, the Building phase, and the VR phase.

### Modeling Phase

The first phase in the creation of the training module was the modeling phase. This was created in Unity via the Unity asset store. For the environment and AI avatars as well as the animation, I used Unity models, materials, and prefabs to complete the entire environment and build various prototypes. The intent was to have a real feel of the environment from a user perspective. For instance, the user was in the middle of a busy city with police cars, ambulances, military-like vehicles, medical, police officers responding to an active shooter and providing medical aid to a

victim. The city was meant to capture all the essentials of a chaotic busy city environment. There are over fifty prototypes on the base which include but not limited to skyscrapers, parks, office buildings, people and vehicles as well as various building structures.

The city has all the essentials of what is known to be in or around the city. Vehicles, doctors, policemen, citizens, parks, chairs, restaurants, streets, street signs, etc, are all located in the city. The has planes on the street, as shown in Figure 4. The buildings' numerous stories providing an idea of skyline view, cars, and trucks, picnic tables, and lights as shown in Figure 3. The cars, police cruisers, ambulances, and various vehicles move about the city. People are walking around downtown in the city. Professional workers are heading to work and running around the city as first responders arrive to the scene of a crime as shown in Figure 5.

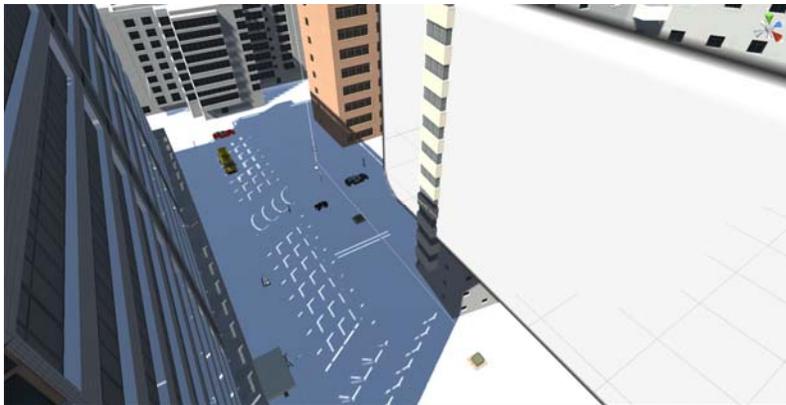


Figure 3: Top-down skyline view of city buildings.



Figure 4: View of the ambulance on the street.

Figure 4 shows the ambulance as it heads to the scene of the crime. The ambulance and police cruiser was coordinated to respond to the scene of the crime. The avatars had a simple animation of walking up and down the sidewalk while the cars drove along the street.



Figure 5: View of ambulances and cop cars responding to the scene of a crime.

## Building Phase

Once all the models were imported into Unity3D, such as, the vehicles, avatars, streets, buildings, signs, etc., it was time to work on the C# scripts and extra objects that were not available or created via other software tools. One of the most important parts was creating the animation of the multi-players, police cars, trucks, ambulance, people, and sound. The city and buildings were models imported from the Unity assets store that was used to make the downtown environment look busy and active during an active emergency response by first responders, but it needed to be moving so that it didn't look stationary nor inactive creating a static scene during an emergency event. Figure 5 shows highlights first responders of ambulances and cop cars responding to the scene of a crime.

Other important models that were created are the avatars and their appropriate emergency equipment. The animation of the first responders running to the scene of the crime was not made to look super genuine; the objective to simulate a medical team and law enforcement responding to an active emergency. So, the animation was created, manipulated, and directed so the first responders' avatars would run to the scene of the crime. The medical and law enforcement team needed to move wherever the user clicked on them without the user having the ability to manipulate the run direction or destination. It was a challenge to make the running look truthful due to the lack of moving the model used when running. After continuous adjustments, the model was able to run in simi-realistic motion using multiple hack configuration in Unity3D.

Implementing the capability to have multi-players in the same environment work properly was one of the challenges during the modeling and building phase. Not only with joining to users with their avatars to the same collaboration room but also moving about the environment with capability interact with the models in downtown city-like 3D ambiance. To incorporate the multi-players

capability in the downtown city to 3D environment requires the use of Photon Unity Networking (PUN). PUN is a Unity package for multiplayer games. It has flexible matchmaking that allows multi-players into rooms where objects can be synced over the network. With the use of RPCs, Custom Properties and various Photon events are just some of the features that were implemented in this project. The communication technology proves to be fast and reliable via the Photon server. Due to cloud-like technology, this prevents peer-to-peer single connection.

The AI is using the AI pathfinding feature within Unity3D. Unity makes it simple to create an object that follows a path when creating an object such as vehicles, avatars, objects in the scene, etc. via AI (Artificial Intelligence). It's important to specify paths for my object that I want to move during emergency evacuations in the downtown city. Avatar pathfinding has been useful for all types of objects that were created during my project. This pathfinding is often done by using a navigation mesh, or 'navmesh,' to find their way around. A navmesh is a type of data structure that is applied to objects to aid in pathfinding through complicated spaces.

As with many things, Unity has a modest way to build a pathfinding system for my objects in this project. This process allowed me to get my basic AI off the ground quickly and allowed me to create a more complex AI from there. In this project, I have created a navigation mesh that the first responders will use to make their way to several points that I've placed on the city 3D environment. I crafted an area that can 'bake' a navigation mesh in to start, selected an object, such as an ambulance, and gave the police cruiser a script that it will use to travel to different waypoints. From there, I've set up these waypoints and assign them to different locations to create a path for the citizens, medical staff, or law enforcement to follow endlessly.

## Virtual Reality Phase

The virtual reality phase is the process of integrating virtual reality in the module using Unity3D. Unity is a cross-platform game engine developed to extend the support of more than 25 platforms. The engine can be used to create three-dimensional, two-dimensional, virtual reality, and augmented reality games, as well as simulations and other experiences. This IDE allowed the multi-player movement to be accessed visually in a 3D city model game engine.

## Emergency response training module

The training module has the basic requirements needed to train and recruit first responders. The module was exported to a .exe to make it runnable on most systems. No additional hardware needs other than one's personal computer. The important parts of the training module are the GUI and the interactions.

### GUI

The GUI is always active inside and outside of the model. When the user walks around on the street, there will be a menu that the user can interact with. The user will have the option of choosing an item on the menu by simply looking at the option and clicking the mouse button or keyboard. The menu controls two things in the environment. The first thing is adding a simple emergency scene or a normal scene where you can scroll around to view the different locations in the city.

Within the city, there are numerous objects that the user can interact with — buildings, cars, restaurants, parks, ambulance, police cruisers, etc.

### Interactions

The interactions in this module are available via the keyboard and mouse. The mousepad user-control buttons will bring up the environment and allow you to scroll through the city scene.

## Future Works

The future works are highlighted below:

- Interactive guided tutorial on how to build your EVAC models in the 3D environment
- Making the model more interactive and provide visual and haptic feedback when incorrect connections are made
- Include a scoring mechanism on how well a user performed
- Human factors opportunities for extended studies/future work
- Create and build multiple natural disasters
- Measures – attentiveness
- Duration of gameplay
- Initial player selection

## Acknowledgments

I want to give a special thanks to the various Photon and Unity3D Youtube channels that showed me how to get certain things set up such as setting up the Unity3D and Visual Studio for C# coding.