# Enhancing Mass casualty incident training with Virtual Reality and Artificial Intelligence


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## Introduction

Training emergency response personnel for mass casualty incidents (MCI) is important, but the cost can be high as such incidents occur rarely and physical simulation is resource-intensive. Recently developed technologies such as virtual reality (VR) and artificial intelligence (AI) could provide a low-cost and high-efficiency solution for MCI training. This research project aims to develop an enhanced VR learning tool in MCI training. The VR learning tool includes a data collection platform and several Artificial Intelligence (AI) evaluation methods. We have defined the training tasks with the assistance of medical professionals, and by reviewing the literature. The data collection platform has been developed and an experiment will be conducted to capture data in training simulations. This data will be analyzed using AI and statistical approaches to help improve its effectiveness.

## Design of Study

There are three major components in our research framework. The central one is the **VR learning tool** we are going to build. To build it, we have a component of **development tools**; and to evaluate it, we have a component of **VR training experiment**. Figure 1 shows the overview of our research framework and the sub-components of each major component.

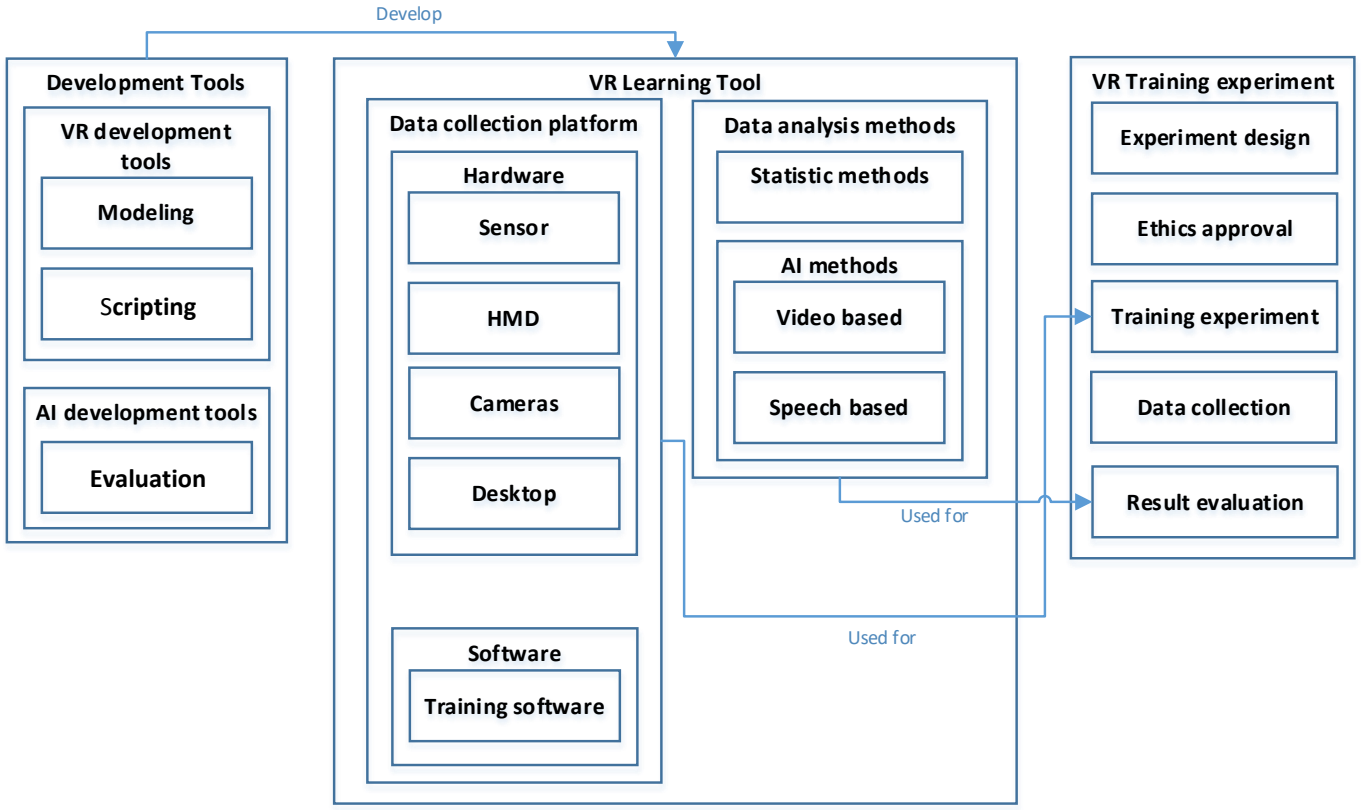


Figure 1: Research Framework

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## Major Component : Development Tools

We have two types of development tools. One is for VR, and the other is for AI. The VR development tools consist of Modelling and Scripting tool. We use modelling tools to build the objects, and assemble those objects in Unity Engine to build VR scenario. AI development tools include various development environments. We implement the AI algorithms based in those environment. Figure 2 shows the development tool used.

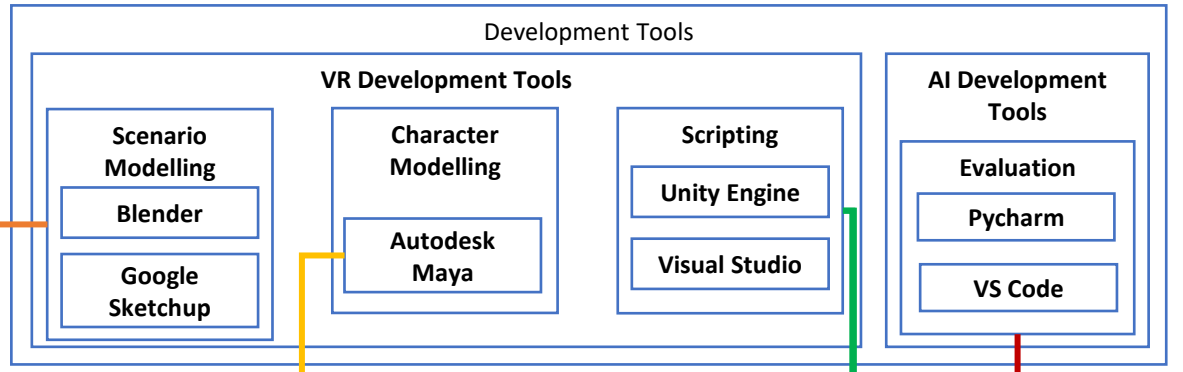


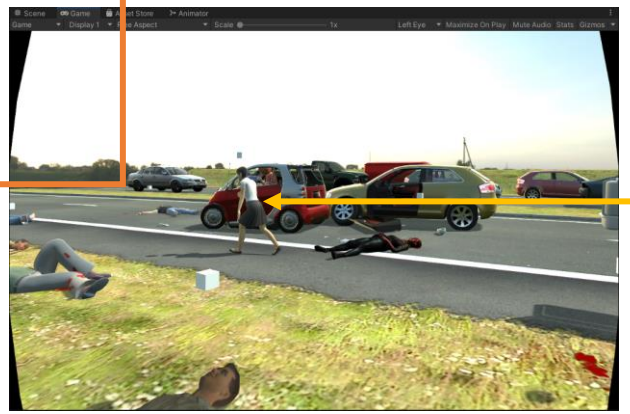

Figure 2: Development Tools

Create objects and environments

Create characters

VR scripting

Data evaluation



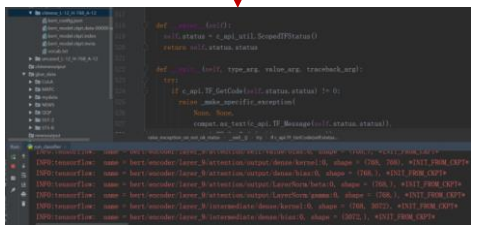
```
else if (other.gameObject.tag == "temp_Simulator")
{

    temperature = patient.gameObject.GetComponent<vital_Sign
    spo2 = patient.gameObject.GetComponent<vital_Sign>().spo

    GameObject.Find("Canvas/HUD_Text").GetComponent<Text>().

    //HUDUI_Text.GetComponent<Text>().text = "hear rate";

}
```



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## Major Component: VR Learning Tool

In this research project, we have designed a VR learning tool to simulate MCI scenes and train triage skills for paramedics. The VR learning tool consists of a Data collection platform and a set of Data analysis methods.

## Data Collection Platform

The data collection platform consists of hardware and software. Figure 3 shows the detailed components of the data collection platform.

- **Hardware**: Head mounted device (HMD), motion sensors, controllers, camera, and desktop computer. (See Figure 4).
- **Software**: several MCI triage scenarios. Currently a car crash scenario and an earthquake scenario are developed. (See Figure 5)

## Data Analysis Methods

To evaluate the training, we plan to collect four types of data from the experiments: personal information, sensor data, video data and speech data. We use

- **Statistical method** on **personal information and sensor data** to evaluate the participants' background and task completion time.
- **Video-based body action recognition method** on **video data** to evaluate the behavioral patterns during the training. See Figure 6 for the result of using Spatial Temporal Graph Convolution Networks (ST-GCN).
- **Speech-based method** on **speech data** to evaluate the semantic accuracy of participant's triage report. See Figure 7 for the result of using BERT.

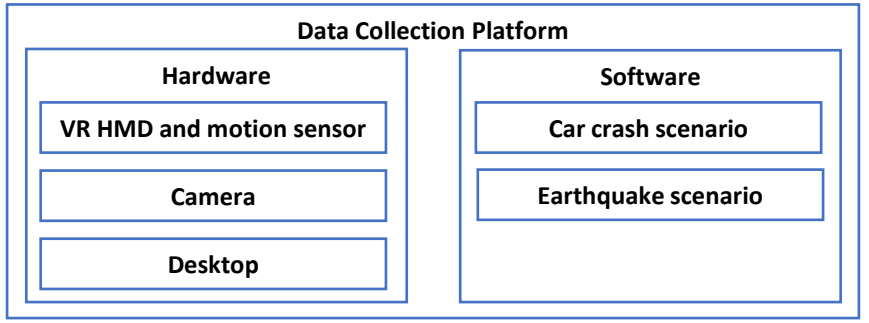


Figure 3: Data Collection Platform

Figure 4: VR HMD, motion sensor, and controller

Figure 5: Software (L: Car crash, R: Earthquake)

Figure 6: Body Action Recognition

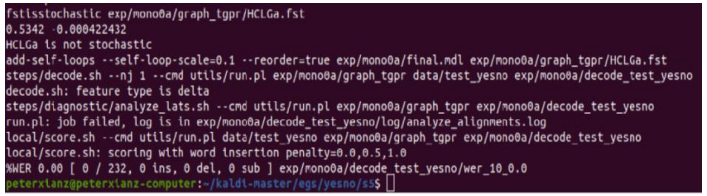


Figure 7: Semantic evaluation from BERT

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## Major Component : VR Training Experiment

We plan to recruit **10-15 participants**, and they who meet the inclusion criteria to join the research project. Ethics approval has been completed. The experiment is scheduled to be conducted in early 2022, and the duration is 1-1.5 months. Figure 8 shows the training session environment setup.

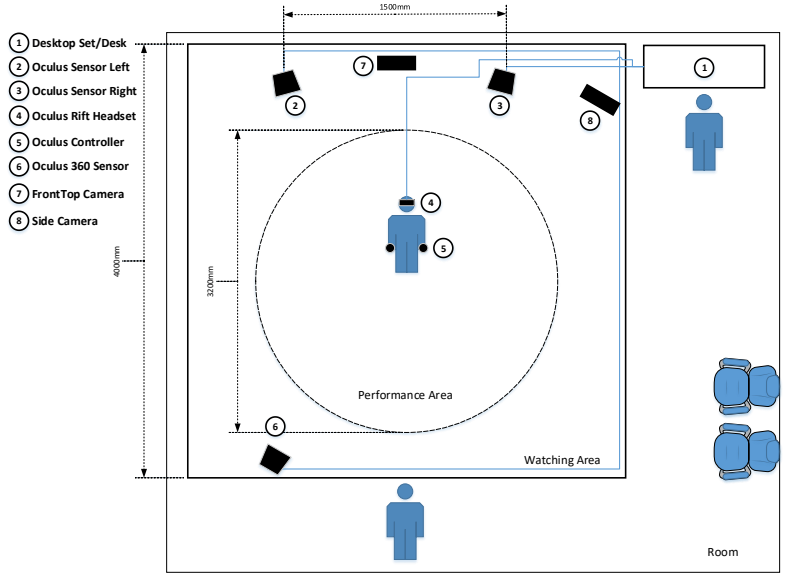


Figure 8: Training Session Environment Setup

## Conclusion

The VR learning tool is hoped to benefit MCI training in a number of ways, including:

1. Satisfy the functionality requirement of MCI skill training;
2. High flexibility and extensibility;
3. Low deployment cost;

Also, the involvement of AI evaluation methods can provide advanced assessment metrics for the training.

## Future Work

The future research could be conducted based on following areas:

1. Multi-participant interactions during the training;
2. More realistic virtual patient feedback;

## Acknowledgement


The authors would like to thank Prof. Albert Yeap and Dr. Graham Howie for their guide and professional suggestions on this work.