Safety Is Everything: Design of an AR·VR Training Simulator for Radiation Emergency Response

DongSeok Song

1 Company Description

Novatech is at the forefront of the Extended Reality (XR) market. Novatech addresses current workplace safety issues, particularly in the industrial sector, and aims to provide reliable solutions to ensure worker safety through its XR technology. Novatech's services provide realistic simulations that can be used in employee training to reduce risks in biohazard environments.

Founded in 2015, Novatech has worked with both large and small industrial safety-related clients since its inception, and is valued by most for maximising their return on investment.

Novatech's primary objective is to provide products and services that improve safety and increase productivity in the industrial workplace. Novatech's XR technology provides a realistic simulation that reduces the

D. Song (✉)
Novatech, Seoul, Korea
e-mail: song@novatek.kr

T. Jung, M. C. tom Dieck (eds.), *XR-Metaverse Cases*, Business Guides on the Go,
https://doi.org/10.1007/978-3-031-30566-5_8

operational burden on companies, minimises the costs incurred and saves time. The virtual environment can be used as a training system to help professionals become more familiar with emergency response at biohazard sites such as nuclear plants. The service also secures efficient product exportation for companies, which improves customer satisfaction and leverages their competitiveness. Novatech also brings innovative, therapeutic value to the medical market with its XR-based rehabilitation gears.

2 Project Summary

The "Design of an AR·VR Training Simulator for Radiation Emergency Response" project aims to create a realistic and immersive training simulator for emergency responders in the event of a radiation emergency. The project will use both augmented reality (AR) and virtual reality (VR) technologies to simulate the potential dangers of a radiation emergency and provide training for emergency responders to learn how to respond effectively. The training simulator will feature a 3D virtual environment that will allow emergency responders to explore and interact with the simulated environment. The simulator will provide a realistic representation of radiation sources, as well as simulated radiation detection equipment and protective gear. The use of AR technology will allow for the overlay of digital information onto the real world, allowing for more immersive and interactive training scenarios. The project will be developed in collaboration with emergency responders and radiation safety experts to ensure the accuracy and relevance of the training scenarios. The ultimate goal of the project is to provide emergency responders with a safe and effective way to train for radiation emergency response, which will ultimately help to protect the public and the environment in the event of a real-world emergency. The completed training simulator will be an innovative and effective tool for training emergency responders, and has the potential to significantly improve the effectiveness of emergency response efforts in the event of a radiation emergency.

3 Project Details

3.1 Challenge

In order for the government to guarantee they are delivering health and safety policy infrastructure for employee, the company must ensure the workforce are fully trained and competent in the work they are undertaking. Most training and experience occur in emergency environments where there is a necessity for a prompt decision. Nuclear accidents can be irreversible and catastrophic, so it is important to prevent accidents and respond quickly in the event of an emergency. There are currently 24 nuclear power plants in operation in Korea (Fig. 1) with four more under construction in Uljin and Ulsan, Gyeongbuk.

The purpose of the Practice of VR Radiation Exposure Treatment Training is to improve your ability to respond to radiation emergencies by practising medical techniques and behaviours that can only be used in an emergency, or training by implementing the environment and equipment you will need to treat radiation compound injury with virtual reality.

Fig. 1 Example of a nuclear power plant: Kori Nuclear in Korea

3.2 Solution

This solution was developed as an alternative to standard education and training systems for radiation emergency situations, as it restricts the practical description of radiation disasters and emergencies in real situations.

The system is also used to give the medical team a better understanding of site environments and risks even if they've never experienced the situation where there is radiation exposure before—closing a gap between the real world and the virtual world in a workflow (Fig. 2).

The practice of the treatment process has various contents such as granting a specified virtual space, starting training with the virtual patient influx, and assigning simulated patient situations. This treatment process is including how to configure the equipment for each level of radioactive contamination, severity of damage, symptoms of exposure, etc.

Also, the training team can implement treatment measures for decontamination. For example, they can learn how to classify patients with combined radiation damage efficiently and get knowledge about dry and wet decontamination and medical technique. Furthermore, the whole process of medical treatment is included in this training simulator. It is also important to know not only the way to treat radiation exposure patients but also the process for transferring patients to another hospital, hospitalisation, outpatient tracking, and finally returning home safely.

We are developing the 3-Point Tracking Technology to see the actions of other treatments that calculates the position of the head-mounted display and the position information of the hand to generate the movement of the entire body to visualise the movement of the other person.

Applying URP standards for Universal Render Pipeline technology is also implemented to provide realistic visuals by implementing materialisation of realistic visuals and application of global illumination, lighting, and shadow effects.

The main treatment process is VR triage that is providing a virtual environment with an on-site radiation emergency clinic (tent) and portal monitor. At the beginning of the training, trainees start to classify the injured patients with combined radiation damage by various levels of contamination, severity, and appearance in the Portal Monitor to separate contaminated/non-contaminated patients. The severity is divided

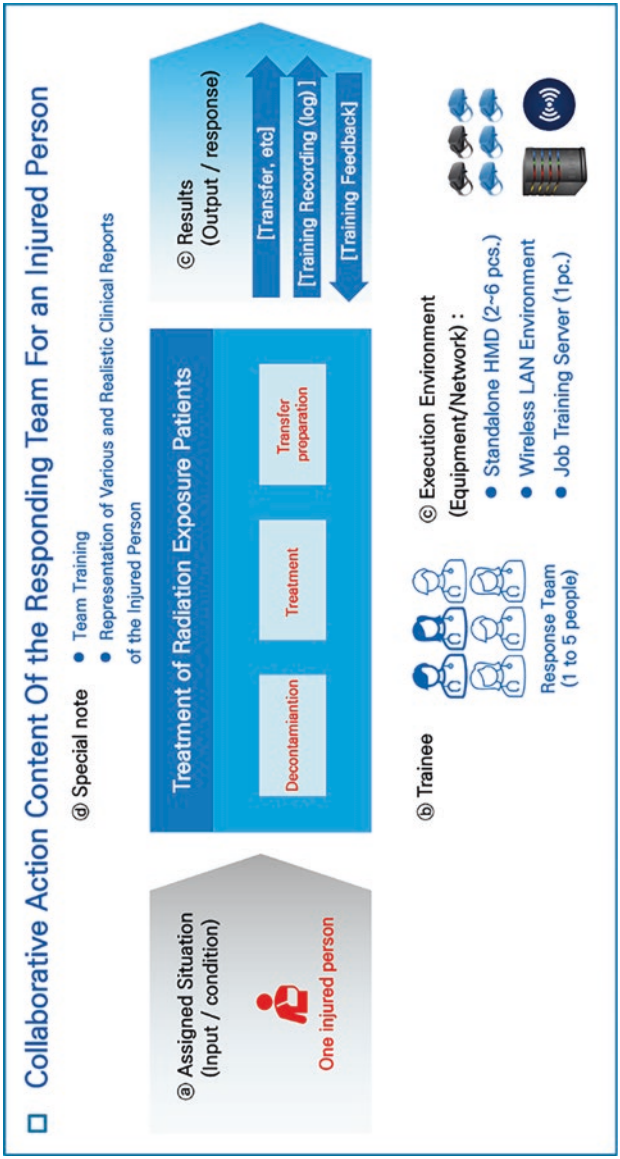

Fig. 2 The practice of the treatment process for radiation exposure patients

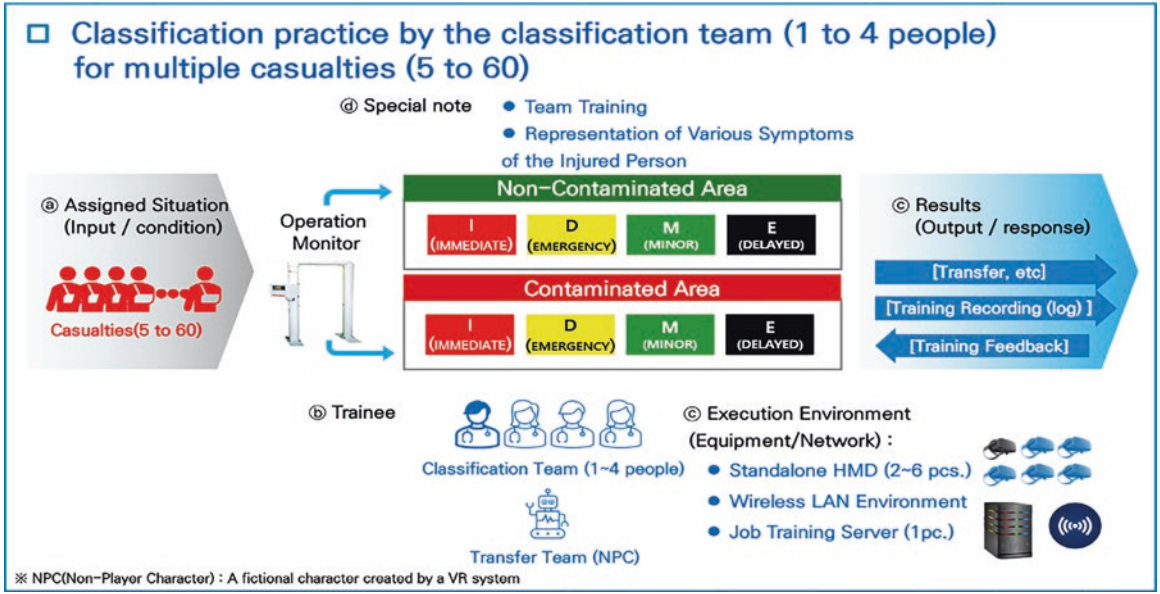

Fig. 3 VR Triage

into four stages: immediate, delayed, minimal, and expectant. Performance assessment is provided in every training simulation after completing a triage and the trainer can get prompt feedback on the training (Fig. 3).

Real-time synchronisation of actions with AI NPCs (Artificial Intelligence Non-Player Characters) was implemented. Patient NPCs implemented with artificial intelligence behave according to assigned attribute values. This enables orientation to the actual situation and allows the trainer to focus on training. The simulator has the function of creating a representative character with a 3D scan and implementing 60 patient characters by making a difference.

3.3 Benefits

There is specific effectiveness for simulating the radiation response training (Fig. 4). First, the benefit is trainee is getting proficiency in complex classification based on severity classification and radiological characteristics, and each member of the Joint Radiation Emergency Care Centre has comprehension of the roles and tasks given by the simulator.

Second, the trainee can expect proficiency in implementing RFID, NFC, and AR glass according to unexplainable radioactive contamination situations. Third, understanding of key processes and detailed

Fig. 4 Virtual reality training in use by Novatech radiation response simulator

procedures are improving in field clinics. Four, they can expect the familiarisation of emergency medical personnel with how to use measuring equipment and improvement of field operation proficiency by equipment.

The eventual purpose is to strengthen emergency medical personnel's capacity to respond to hospitals and identify the factors that need to be considered through the process of solving it in the process of responding to several casualties accompanied by radioactive contamination entering the hospital (Fig. 5).

4 Feedback from End Users

Following successful nationwide safety training, there is excitement within the Novatech Radiation Response Training Simulator as the business is leveraging modern-day technology to an even greater extent. Users of the simulator have remarked upon the realisation that the training system has highlighted their "response in an emergency situation". For most medical staff, it is not that simple to experience high-risk environments such as a radioactive leak.

Learning the process to treat patients is properly presented for each content, and it is evaluated as the contents are appropriately organised in consideration of visibility and readability; the best thing is the representation realistically to feel a sense of reality in the virtual situation.

5 Outlook/Roadmap

Technology planning will be completed by establishing the purpose, development concept map, content, and technical implementation methodology for the eight content components to be developed as virtual augmented reality training simulators.

The general development procedure is carried out by adding detailed requirements through prototype development and reflection of training participants' needs to the general development procedure to maximise training effectiveness.

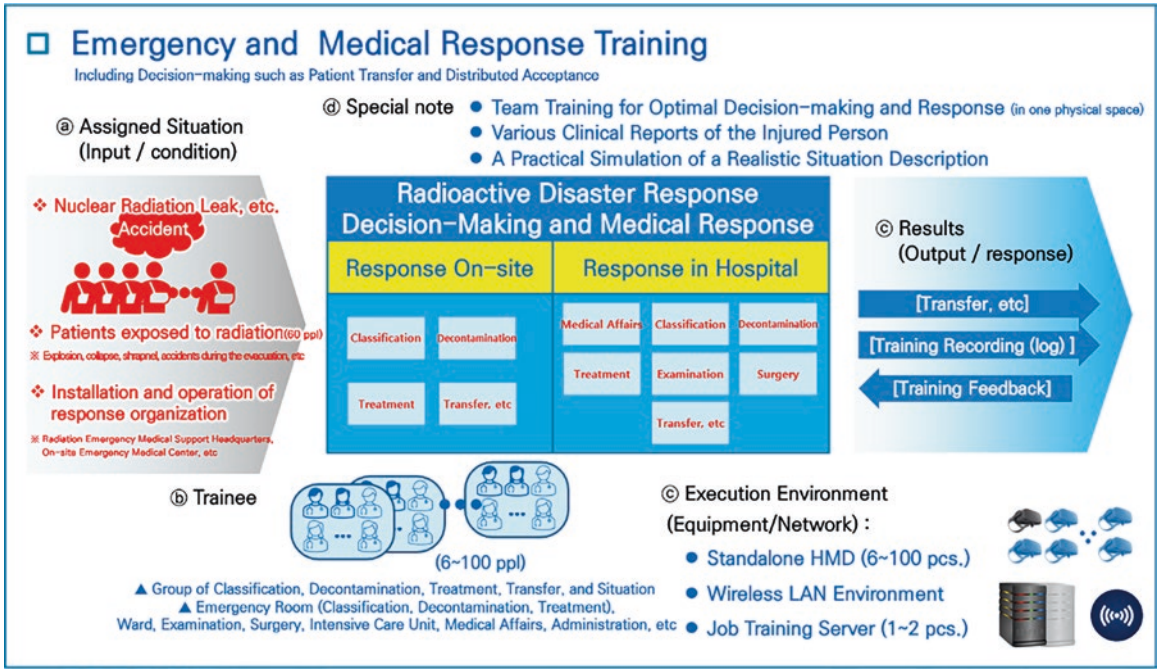

Fig. 5 VR radiological disaster hospital response decision training system

The complete development process starts with planning; then design and prototype development is the next for the following steps. The development team give a confirmation for design in order to check if it is complete or is to be alternative by reflecting field needs.

In the development of specific content, it is judged that the application of mixed reality (MR) is effective for training, and accordingly, research on analysing mixed reality technology and deriving application methods is conducted.

Novatech uses Hololens 2 for glass in the application, and the analysis target for technologies is conducted by real-time image mapping technology of objects and modelling objects after wearing glass and asynchronous processing technology which is the events through UniRX (Reactive Extensions for Unity) provided by UNITY, a development engine. Also, the method of producing mixed reality content is used by Hololens 2 including difficulty level and more.

6 Conclusion

Technical development planning for the seven contents was completed by establishing the purpose, development concept map, content, and technical implementation methodology.

AR and MR measurement practice contents are developed, and the appearance and usage of measuring instruments are virtualised; hence, users can learn freely at any time. Furthermore, the simulator enhances learning how to use measuring equipment by emergency medical personnel and improves on-site operation proficiency by equipment and maximises the effectiveness of education and training through convenient search. In conclusion, the "Design of an AR·VR Training Simulator for Radiation Emergency Response" project offers an innovative solution to the challenges of training emergency responders for radiation emergency response. By using both AR and VR technologies, the simulator provides a realistic and immersive training experience that allows responders to gain practical experience in a simulated environment without risking their safety or the safety of the public.