

Establishment of 3D Interactive Visual Scene and Information Platform for the First Nuclear Power Plant

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I. Research Background :

The decommissioning plan of the first nuclear plant of Taipower has been commenced. On-site operations of nuclear energy facilities are hazardous and complicated. Without proper planning of the operations, the working staff will be exposed to industrial safety and radiation risks which may be due to the reasons of insufficient field experience of personnel, long-term stay in radiation sites, problems with dose exposure, etc. Therefore, this project refers to the literature of nuclear power plants by utilizing BIM and visualization techniques to build associated information systems and to collect the engineering drawings as well as traditional practices and experience from the field experts. Through complete and accurate engineering parameters, a digital model and database designed for the first nuclear power plant is established, using the data above sources with various engineering visualization techniques. User can view and roam in the scene, see radiation survey package point data, review various component and pipe attributes information, simulate the dismantling work, and check dashboard and sensor real-time data.

It is also possible to understand the on-site layout and the presentation of radiation dose distribution under the pre-simulated situation, which significantly reduces the risk of workers' radiation dose.

II. Research Results and Applications :

This research establishes an interactive 3D visualization platform. We use back-end data, engineering data, etc., combine 3D buildings to visualize radiation detection results and component engineering information through a solemn interactive game. The architecture diagram is shown in Figure 1.

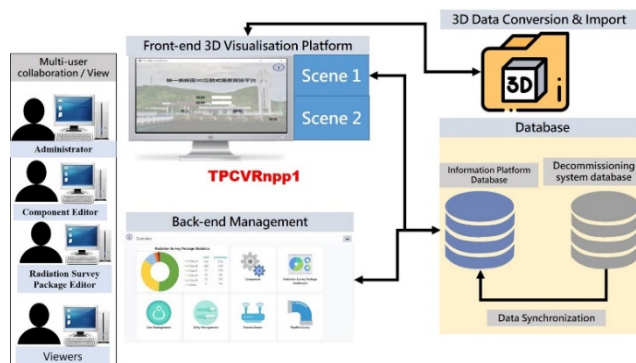


Figure 1 3D vision platform architecture diagram

The back-end management platform can be used to view various reports. It allows each data management department to perform digital management and view component information.

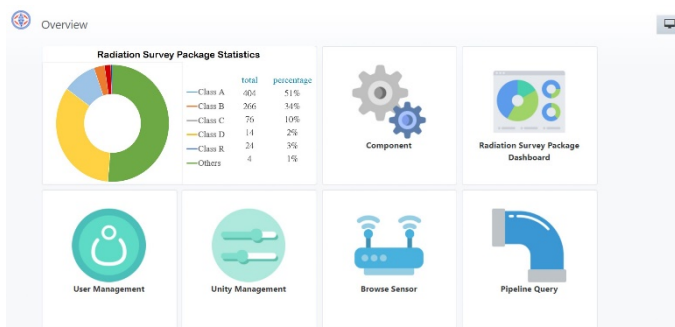


Figure 2 The screen of the background management platform

This research uses Unity 3D to develop the front-end 3D visualisation platform. It can import BIM or CAD files and show the scene changes before and after the component or pipeline is removed. So the subsequent decommissioning team can plan or preview the execution steps.

In the back-end database component or pipeline decommissioning date base, the user can fill in the start and end section component/pipeline/radiation detection point data. The platform will interact with the user at the correct scene location of the demolition read from the back-end database.

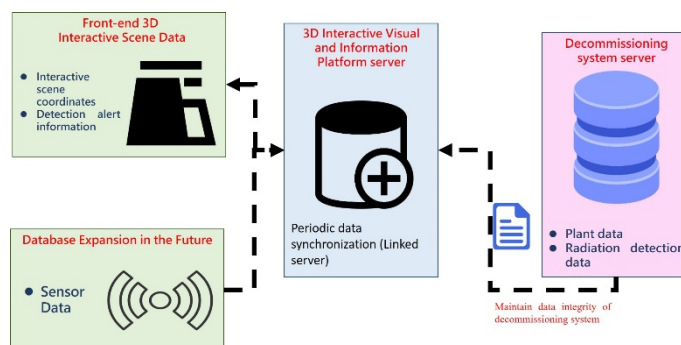


Figure 3 Front-end architecture diagram

This program creates standard information about importing new files of BIM or CAD files. It can enable the building model in the system to interactively present the changes in the decommissioning and demolition work.

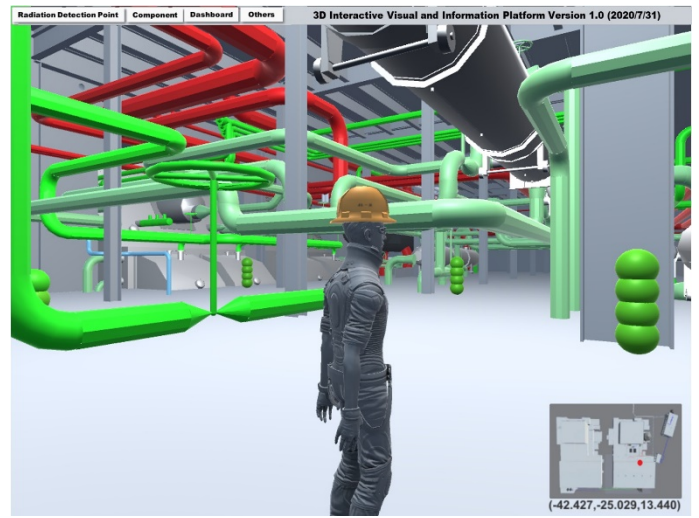


Figure 7 The pipeline to browse the target room



Figure 4 The screen of the front-end 3D platform

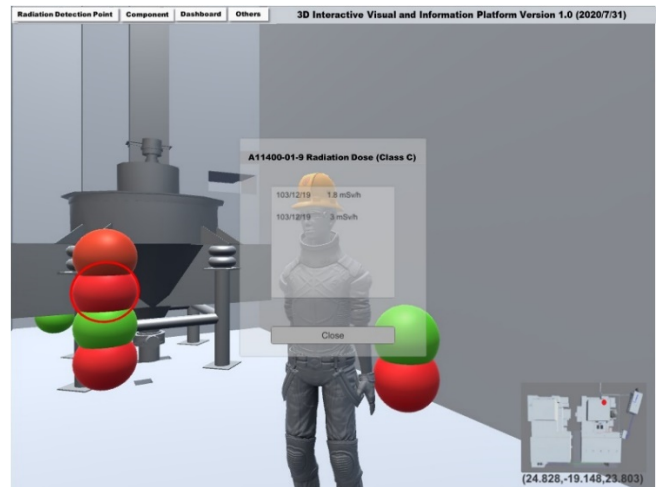


Figure 8 Click an object to display component information

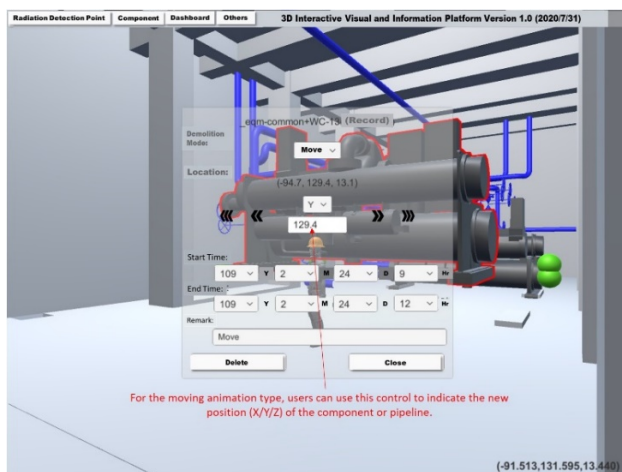


Figure 5 Movable components to simulate removal

Users can roam in the 3D scene with a third-person perspective.

For the location, factory, and room that you want to work, you must understand the site layout, radiation dose distribution, and site component engineering information first. Planning with more detail will reduce the time of person enter the radiation site, and help reduce the amount of radiation accumulated by the personnel, shown in Figure 6, Figure 7, and Figure 8.

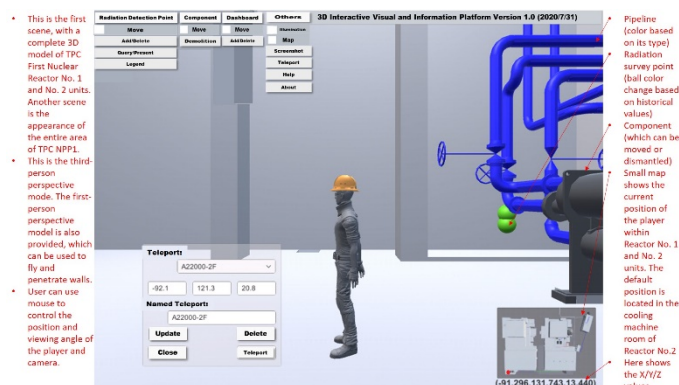


Figure 6 Introduction to screen information

- This is the first scene, with a complete 3D model of TPC First Nuclear Reactor No. 1 and No. 2 units. Another scene is the appearance of the entire area of TPC NPP1.
- This is the third-person perspective mode. The first-person perspective model is also provided, which can be used to fly and penetrate walls. User can use mouse to control the position and viewing angle of the player and camera.
- Pipeline (color based on its type)
- Radiation survey point (ball color change based on historical values)
- Component (which can be moved or dismantled)
- Small map shows the current position of the player within Reactor No. 1 and No. 2 units. The default position is located in the cooling machine room of Reactor No.2 Here shows the X/Y/Z values.