Progress on the Pilot Project 1 until 30.06.2024. (M13-M18)

Improved fire evacuation VR model of a ship engine room

CHALLENGE! To provide an improved, more realistic, albeit safer environment for onboard firefighting training.

HOW? By building a fire scenario in a virtual reality (VR) environment of a ship engine room (ER) based on fire spread results obtained by computational fluid dynamics (CFD) analysis.

WHY? The problem with the current VR models is that the fire is modelled rudimentary, i.e. as a concentrated flame that does not spread, making users less susceptible to the stimulus.

FINAL RESULT→ Functional VR model of fire spread in ship ER, reaching TRL4/TRL5.

GOALS FOR INNO2MARE PROJECT: To advance maritime fire safety and to digitalize the maritime education and training (MET) process.

PROGRESS ON ACTIONS:

Action	Start-End	Accomplished
1. State-of-the-art literature review, existing solutions analysis, mapping research gaps solutions	M1-M3	Yes
2. Selection and design of a representative ship ER	M1-M3	Yes
3. Building a VR model of ER	M4-M6	Yes
4. Developing and defining fire scenarios	M7-M9	Yes
5. CFD modelling of fire spread in ER	M10-M12	Yes
6. Implementing CFD analysis results in VR model	M12-M18	Yes
7. Testing of improved VR model	M19-M30	Not started
8. Equipment procurement & subcontracting	M3-M6	Yes
9. Dissemination	M1-M48	Ongoing

In the following, more details are given on every action performed.

1. <u>State-of-the-art literature review, existing solutions analysis, mapping research gaps solutions</u>

Please see the Progress on Pilot Project 1 until 30.06.2023 (M1-M6).

2. <u>Selection and design of a representative ship ER</u>

Please see the Progress on Pilot Project 1 until 30.06.2023 (M1-M6).

3. <u>Building a VR model of ER</u>

Please see the Progress on Pilot Project 1 until 30.06.2023 (M1-M6).

4. <u>Developing and defining fire scenarios</u>

Please see the Progress on Pilot Project 1 until 31.12.2023 (M7-M12).

5. CFD modelling of fire spread in ER

Please see the Progress on Pilot Project 1 until 31.12.2023 (M7-M12).

6. Implementing CFD analysis results in VR model

Both Smartfire and Unreal use voxels, discrete elements in a 3D grid that encapsulate information about specific points in space. Voxels (volume+pixel) represent a crucial concept in computer graphics, a distinct element capturing information about a particular point's properties, such as colour or density. An integral aspect of voxels is their resolution, influencing the level of detail in 3D representations. Higher resolution translates to smaller voxels, offering greater precision but demanding increased computational resources. Striking the right balance between resolution and performance is a crucial consideration. Although both Smartfire and Unreal use voxels, it is observed that there is no native support for easy transfer of CFD analysis results into the game engine. That is mainly because CFD analysis results are saved in a format of. vtu or .vtk files that are not native to the game engine. However, Unreal engine can import data from the .vdb file type, which is relatively similar to. vtu, meaning that conversion should be possible, but with a custom programming script written in C++. Setting the saves of Smartfire CFD simulation to every time step of 0.2 seconds and 600 seconds of total simulation time resulted in 3000 .vtu files saved, with an overall size of 60 GB. During the conversion process to .vdb files, only smoke-related data was extracted and retained to save on the size of data needed to import. The result was 3000 .vdb files with a size of 3 GB. Smoke data from the .vdb file was imported and represented correctly in the VR environment. Implementation of CFD analysis results in the VR model has been done for fire scenario no. 1 (fire on the main engine) so far in the RP1, *Figure 1*. Another two scenarios will be transferred from CFD to VR in M16-M18, as planned at the beginning of the project.
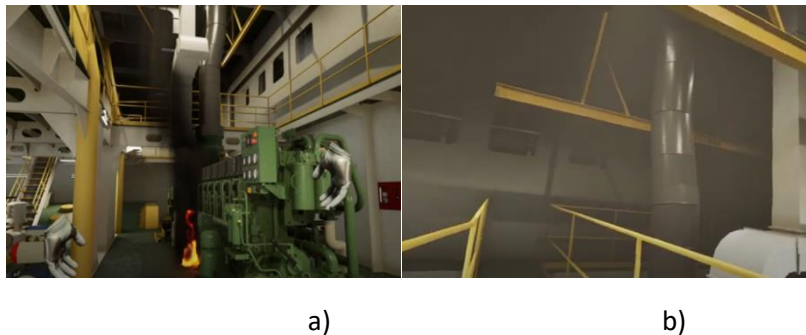

a)   b)

Figure 1: Fire and smoke in the ER: a) lower deck, b) upper deck.

7. Testing of improved VR model

Not yet started.

8. Equipment procurement & subcontracting

Please see Progress on Pilot Project 1 until 30.06.2023 (M1-M6).

9. <u>Dissemination</u>

INNO2MARE project and Pilot Project 1 have been presented at the following events:

1. UNIRI „Days of e-learning" 2024.
2. UNIRI „River of technology" 2024.
3. PFRI „Career Day" 2024.