Exploiting Augmented Reality for improved training and safety scenarios for large passenger ships

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Introduction

Recent advances of Augmented Reality (AR) and Virtual Reality (VR) technology, has made this technology attractive for the cruise line industry. The AR and VR applications the cruise line sector is targeting is mainly related in enhancing the passenger experience on-board, i.e. using augmented reality virtual excursions [1], or in providing virtual reality gaming for cruise passengers [2]. As it is reported in [3] advanced AR, VR and XVR (mixed virtual reality) technologies will facilitate a hyper-personalised entertainment future for the cruise passengers. Besides the use of immersive technologies such as VR in marine education and training and ship bridge simulators, another domain where AR/VR has gained recently interest in maritime industry and in particular due to COVID-19 crisis, is related to remote and augmented surveys and ship inspections, already offered by leading ship classification societies. While AR/VR technology is constantly growing in several application domains such as health, manufacturing, education, safety training and retail, its full potentials for the use for real-world applications [4] in real environment of large passenger ships for training and safety applications have not been exploited yet.

To this end, tailored AR applications for training and safety applications for large passenger ships as part of the EU funded H2020 project SafePASS [5,6] are presented in this paper abstract. SafePASS is an EU H2020 funded project aiming to radically redefine the evacuation processes, evacuation systems and international standards for passenger ships in all environments. SafePASS aims to develop a combination of innovative systems that will collectively monitor, process and inform during emergencies both safety personnel and passengers of the optimal evacuation routes, coupled with advanced, intuitive and easy to use, lifesaving appliances that go beyond current state-of-the-art. This includes AR applications targeting both training of crew personnel as well as safety related scenarios in case of evacuation of large passenger ships.

SafePASS AR toolkit application environment

SafePASS AR toolkit is a set of AR applications being developed, in order to assist and enhance already existing training and emergency procedures and tools for large passenger ships. The SafePASS AR toolkit includes three different applications. The SafePASS AR Training Tool, the SafePASS AR Crew Rescue Assistant, the SafePASS AR Passenger Assistant Application. Each application of the AR toolkit is not only focused in fulfilling different aspects and scenarios of emergencies and trainings, but also targets different actors involved in the safety and emergency management process as well as in the crew training process. Due to the maritime application environment of the proposed AR toolkit, special attention needs to be taken in the maritime regulatory landscape imposed by international organizations an conventions such as, the International Maritime Organization (IMO), the International Convention for the Safety of Life at Sea (SOLAS), as well as the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STWC). In addition, the emergency phases on-board of large passenger ships and the different alarm phases, actors and procedures as summarized in Figure 1, needs to be carefully analyzed, in order to adapt to the specific operational environment.

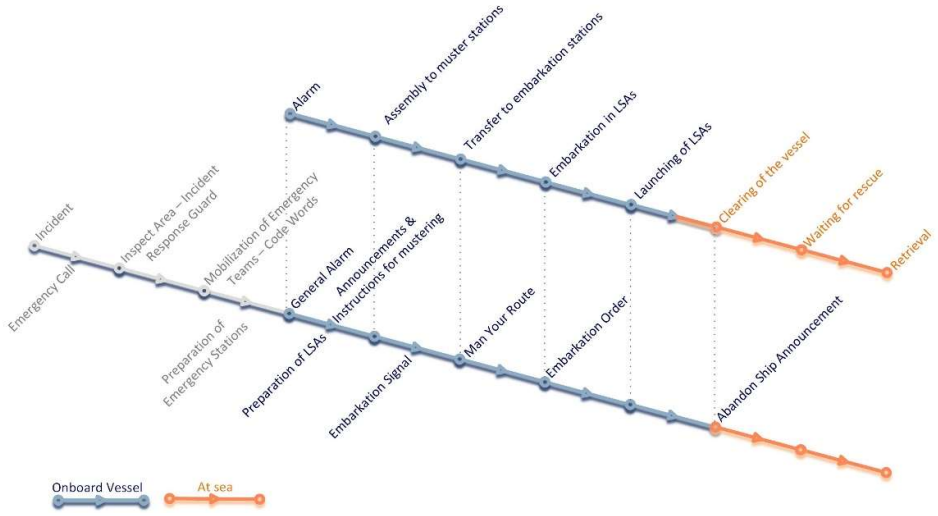

Figure 1. Emergency phases and alarm signals from incident to rescue on passenger ships

AR toolkit application development

The SafePASS AR Training Tool is an Augmented Reality application that consists of two parts. The first part targets to assist crew members to train on handling Life Saving Appliances (LSAs), such as life boats, life rafts and mass evacuation systems through various scenarios provided. The training is accomplished on a virtual LSA (3D model) allowing users to interact with it in order to successfully accomplish each step of the training scenario. For each step useful information are provided through images, text, videos and animations on the corresponding virtual parts of the LSA. The second part of this application aids crew members during the LSA maintenance procedure. It provides the necessary steps for the maintenance along with useful annotations on the actual equipment of the ship. This application is developed for the Hololens 2 [7]. The respective mock-ups are depicted in Figure 2.

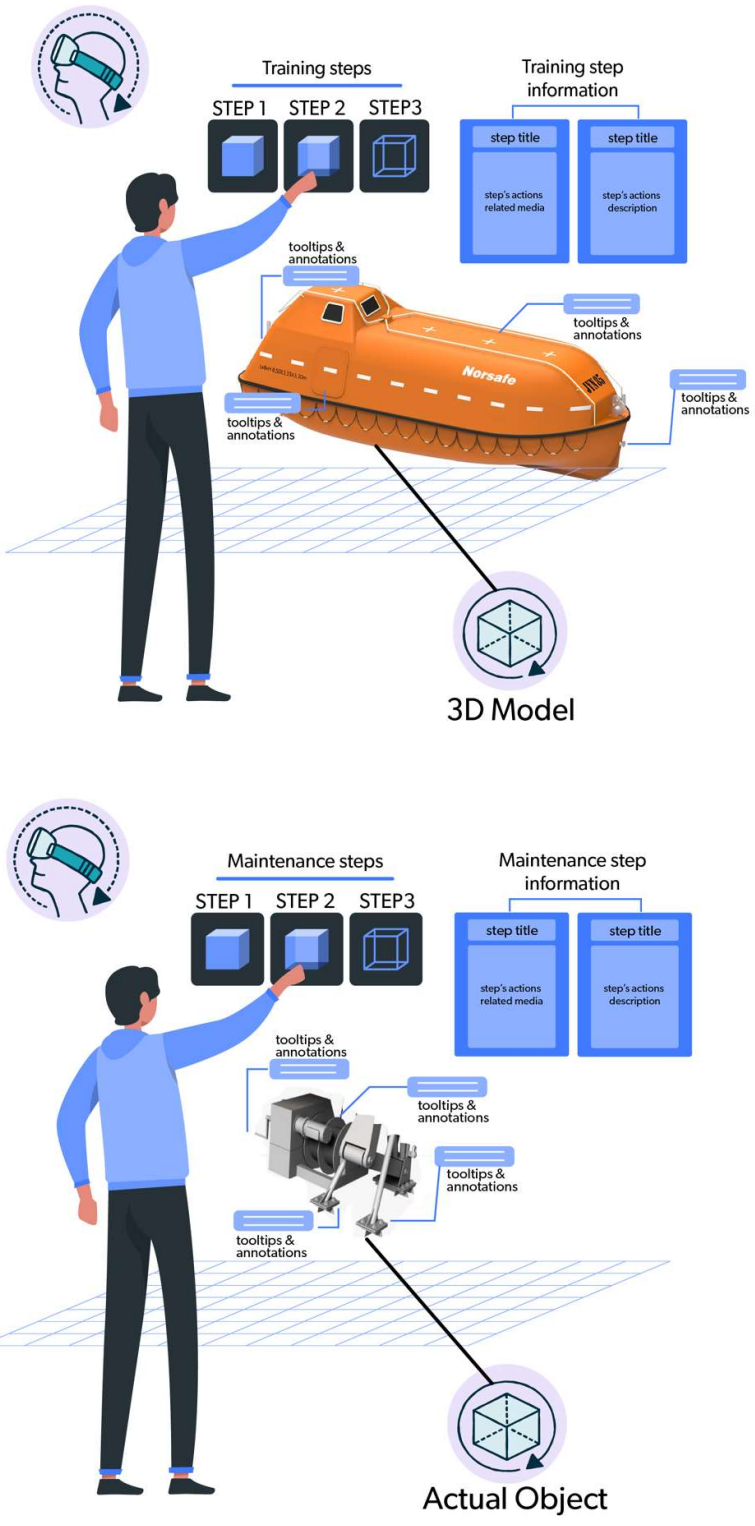

Figure 2. Mock-ups of the AR crew training application

The SafePASS Crew Rescue Assistant is an application developed on Hololens2 and used by ship's crew members responsible for assisting passengers in danger. The application as a first step notifies a crew member that there is a passenger in need along with all necessary information. This information includes position, status and special health conditions of the

passenger collected by the central SafePASS system. As a second step it navigates the crew member to the passenger through an optimal safe route provided by the central SafePASS system (as illustrated in Figure 3). For the navigation, the application uses an indoor localization system based on Ultra-Wideband technology installed along with Hololens2 spatial awareness capabilities.

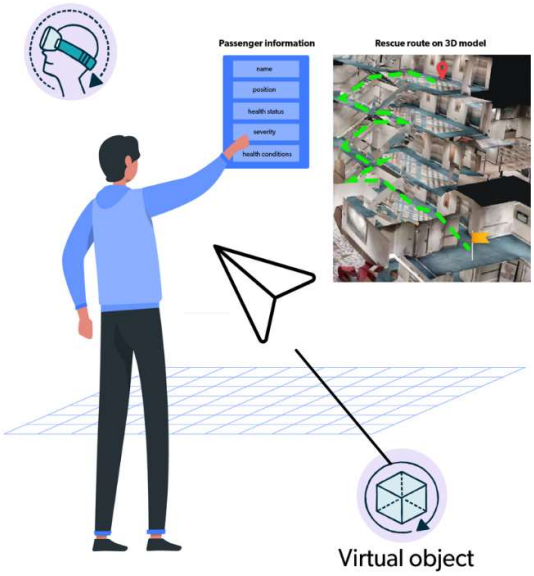

Figure 4. Mock-up SafePASS Crew rescue assistant application

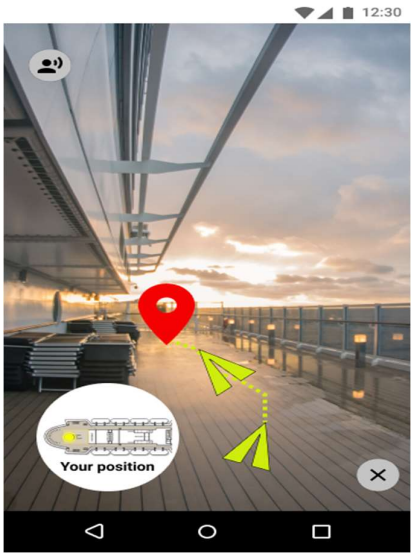

Figure 3. Mock-up SafePASS passenger assistant application

The SafePASS Passenger Assistant (Figure 4) is an application developed for mobile devices and used by ship's passengers. The application requests a personalized evacuation route to the nearest safe point from the central SafePASS system. Since the route is provided it navigates the user using augmented features along with audio assistance. For the navigation to keep track of passenger's position the application uses the indoor localization system installed.

Conclusions

The AR applications will be tested in real environment on a large cruise ship, as part of the integration, demonstration and validation activities of the SafePASS project. Nevertheless, some limitations of testing the AR applications in real emergency conditions on a ship (i.e. smoke, fire), how to emulate human stress factor and ship conditions such as ship leaning need to be addressed appropriately. On the other hand, technical challenges related to the navigation feature through the use of the indoor localization system combined with the spatial awareness will be further studied.

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expressed herein are those of the authors and the European Commission is not responsible for any use that may be made of the information it contains.

References

[1] Arlati S., Spoladore D., Baldassini D., Sacco M., Greci L. (2018) VirtualCruiseTour: An AR/VR Application to Promote Shore Excursions on Cruise Ships. In: De Paolis L., Bourdot P. (eds) Augmented Reality, Virtual Reality, and Computer Graphics. AVR 2018. Lecture Notes in Computer Science, vol 10850. Springer, Cham. https://doi.org/10.1007/978-3-319-95270-3_

[2] https://www.royalcaribbean.com/cruise-activities/sky-pad

[3] MSC Cruises: The Future Guest Experience, http://cdn.msccruises-platform.com/msc/press/media/press-materials/attachments/msc-cruises-the-future-guest-experience-full-report-low-res.pdf

[4] Mallam, S.C.; Nazir, S.; Renganayagalu, S.K. Rethinking Maritime Education, Training, and Operations in the Digital Era: Applications for Emerging Immersive Technologies. J. Mar. Sci. Eng. 2019, 7, 428.

[5] http://www.safepass-project.eu/

[6] Boulougouris E., Vassalos D., Stefanidis F., Karaseitanidis G., Karagiannidis L., Amditis A., Ventikos N, Kanakidis D., Petrantonakis D. (2020), SafePASS – Transforming Marine Accident Response, Proceedings of 8th Transport Research Arena TRA 2020, April 27-30, 2020, Helsinki, Finland

[7] https://www.microsoft.com/en-us/hololens