Damian Filipkowski
Akademia Morska w Gdyni

ANALYSIS OF POSSIBLE USE OF SOLUTIONS DEFINED AS AUGMENTED REALITY IN MARINE NAVIGATION AND SEA TRANSPORTATION

ABSTRACT

This article is the effect of research works on modeling of data transfer between ship and ship or ship and shore station consist with assumption of e-Navigation system. The article attempts to analyze how the tools defined as Augmented Reality(AR) can be adapted and used in the process of navigation and generally in maritime transport. Concept of Augmented Reality is not new. It gained popularity with the spread of such devices as PCs, tablets and smart phones. It is believed that solutions that revolutionize everyday life, can contribute to the development of navigation and improve safety in maritime transport. Wherever there is a need for simple and clear presentation of information, there is a room for Augmented Reality. AR enhances the perception of the user through a computer-generated virtual objects that are displayed in real time. What seems to be crucial not only for navigation but also for the entire industry, including maritime transport, virtual objects allows user to perform real tasks. Augmented reality today is widely used in fields such as medicine, marketing, car navigation, army and security forces, hydrology and geology, simulation and training, entertainment and education. Navigation and maritime transport tend to stay a bit behind worldwide trends. This is incomprehensible because possibility of using Augmented Reality solutions in this area seems to be endless.

Keywords:
e-navigation, augmented reality, radiocommunication.

AUGMENTED REALITY DEFINITION

Some researchers define the Augmented Reality as a system associated with special display devices worn on the user's head. Dr. Ronald Azuma of the University

of North Carolina, one of the authorities in this field, he is defining augmented reality as a system [1, 2]:

— combines real and virtual;
— interactive in real time;
— registered in 3-D.

Figuratively speaking, Augmented Reality is a system that change picture of the real world. It expands and complements that picture with virtual (computer generated) objects that seem to coexist in the same space and time. According to dr. Azuma Augmented Reality is a system which is open to new technologies and is not restricted to specific technical solutions. There are several approaches to the subject of Augmented Reality and at the moment there is no limitation to the specific technical devices. According to one conception system includes data processing and presentations, as well as other conception includes also data collection and data transmission [1, 2].

In 1994, Paul Milgram (University of Toronto) and Fumio Kishino (Osaka University) they created the definition of Mixed Reality (MR). Identified it as a reality located somewhere between the ends of the Virtuality Continuum (VR), which is extending from the objects completely real, until the present only and entirely in the virtual environment. The consequence of this is to place the Augmented Reality and Augmented Virtuality (VR) between these boundaries [6, 7].

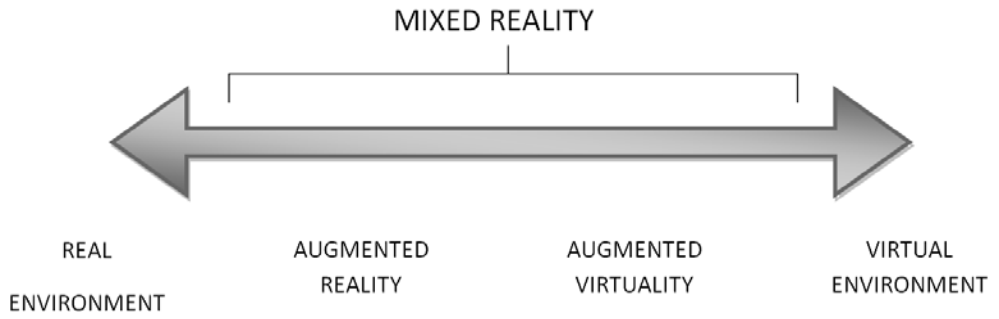

Fig. 1. Reality/Virtuality Continuum

Source: P. Milgram, Augmented reality: a class of displays on the reality-virtuality continuum, Telemanipulator and Telepresence Technologies, 1994.

This continuum is extended in figure 3 in two dimensions. The level of virtuality of the information is presented on the horizontal axis. In the literature on the vertical axis of the 2D continuum there is very often presented mediality [5]. Mediality

is a concept rather nebulous and vague so here author treats mediality as accessibility and usefulness of information presented. We can change the level of mediality by using different ways of presenting information. A measure of mediality as defined by the author is assessment of suitability and accessibility of information presented. If we assume that the point *R* is unmodified reality and virtuality is growing with the *V* axis, we can find somewhere between points *R* and *V* both the Augmented Reality, but also Augmented Virtuality. With the increase in value of the abscissa (along axis *M*) increases the level of usability and accessibility of information presented. Over AR and VR (Virtual Reality), we can find a Mediated Reality or Mediated Virtuality or any combination of these two. According to this approach further up and to the right we have a virtual environment in which information is presented in a very mediated way and that is accessible to the user which makes it more useful. Figure 2, which is two-dimensional version of the Reality/Virtuality Continuum shows not only the concept of Mixed Reality, but also, in addition to the impact of add-ons (extensions), also takes into account the effects of the piling up of the modification to change, sometimes on purpose diminished reality.

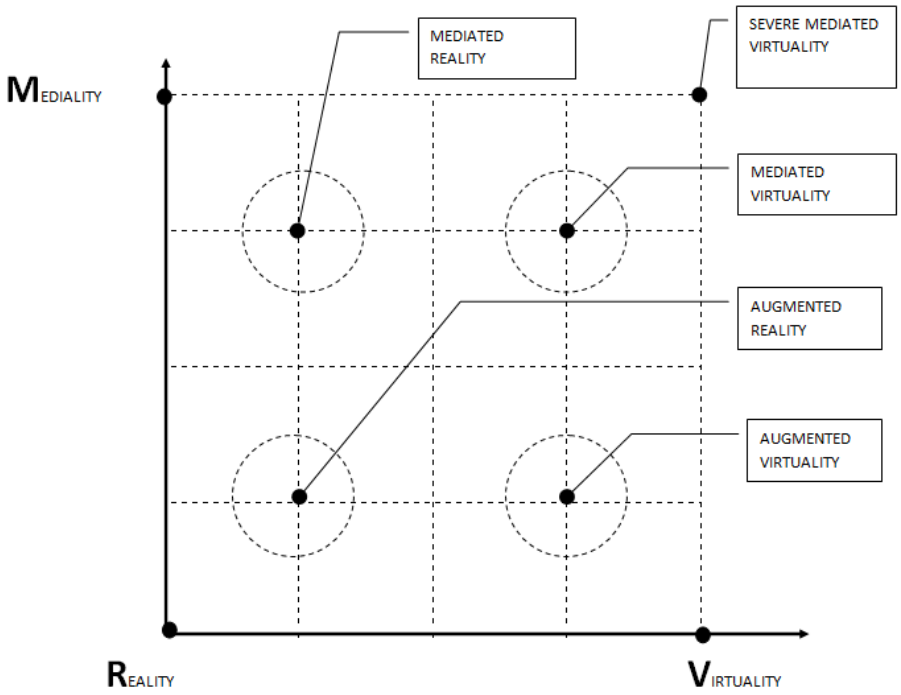

Fig. 2. Two-dimension version of Reality/Virtuality/Mediality Continuum

Source: S. Mann, Mediated Reality with implementations for everyday life, Teleoperators and Virtual Environments, 2002.

Moreover, this diagram shows that reality can be modified in various ways and to varying degrees. It also takes into account that not only the reality may be extended by adding virtual components, but also the virtual world can be expanded by adding elements of reality. The presentation of information is not limited only to the selection of equipment and techniques used but also refers to the more fundamental issues, such as, the number of available sources of information that it receives. Possible to determine the suitability of the information presented in a way will determine the suitability of the presentation. With appropriate assumptions will also determine the suitability of equipment used for processing and presentation of information [5, 6].

It is also worth noting that the term Augmented Virtuality is rarely used today, while the Augmented Reality and Mixed Reality are sometimes used as synonyms.

POSSIBLE USE OF AUGMENTED REALITY IN MARINE NAVIGATION AND SEA TRANSPORTATION

Range of possible use of AR in the marine navigation and sea transportation is very wide. Below are just some examples of applications in arbitrarily selected areas. Augmented Reality tools will be applied wherever you need a clear presentation of data, or expand the skills of perceiving the world by the user.

Safety

Applications installed on mobile phone or other device belonging to a passenger on the ship would show him the shortest escape route during an emergency. On the other hand, rescue team would coordinate the action from the outside, with access to the camera image captured (camera installed for example on the helmet of one of the lifeguards). At the same time they could compare it with a virtual layout of the ship and could have a much easier way to coordinate action (shorter time to reach the victims and casualties). Coordinator with information about the location of victims could be using virtual directions or voice lead Search and Rescue team to the target, even in total darkness or very low visibility (very common condition of the shares and search and rescue, especially when we have to dealing with a fire).

Fig. 3. Presentation of an escape route with the use of Augmented Reality tools

Source: own study.

Navigation

Information about the navigation signs and dangers to navigation together with the presentation of data about other ships would facilitate the navigator to take a proper decision. The addition of decision support systems would give the effect of visible sectors of safe courses and dangerous courses (with appropriate information about speed and motion parameters of other objects). Information about sea bottom in the form of three-dimensional charts and bathymetric profiles facilitate anchoring. Information on current weather and traffic density in specific regions optimize the voyage planning. Virtual buoys and ponds is a solution already used for example in the port of Antwerp.

Protection of Sea Environment

Information about special zones would facilitate proper application of the International Convention for the Prevention of Pollution from Ships (MARPOL), in particular the regulation relating to pollution by oil (Annex I) and the regulations concerning the storage and disposal of waste (Annex V). Navigator could also have information on the regions where the endangered species of marine animals, special areas (nature reserves, etc.) and other related to the protection of marine environment.

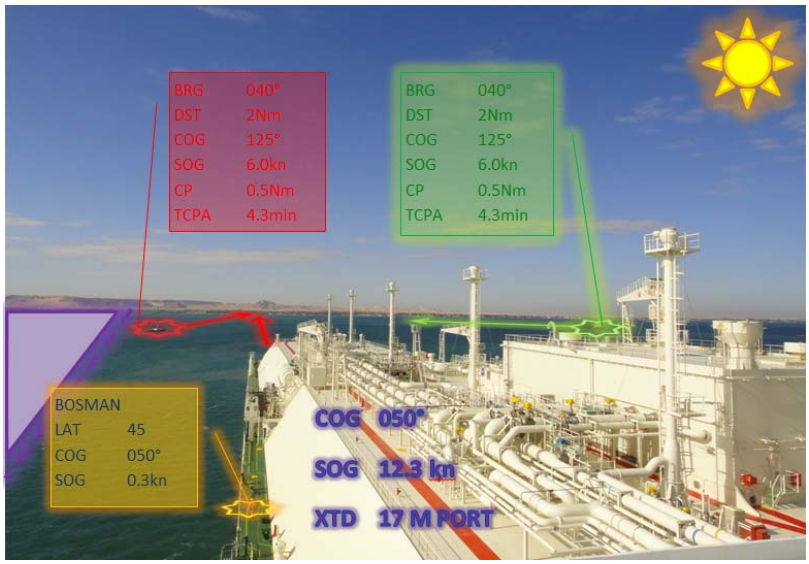

Fig. 4. Presentation of navigation on Bitter Lake (Egypt) using Augmented Reality tools

Source: own study.

Cargo

Depending on the type of cargo and the ship type you could for example see through the walls of a container correctly identifying located in it cargo or to see a specific place in (accordance with stowage plan) where container should be loaded. Information collected by the sensors of temperature, pressure, etc. would facilitate better use of loading equipment and increase control over the cargo operations. Information about the ballast, and recent data from the loading computer would give the officer supervising the loading progress a complete review of the current situation and increase the effectiveness and safety of cargo operations.

Training

In some Universities in the U.S., where much emphasis in the education process is placed on enrichment experiences for students, teachers uses Augmented Reality to activate cognitive processes. The components of many courses are educational trips suplemented with mobile technology what makes lesson even more attractive. An example is the Massachusetts Institute of Technology, in which the participants of the 'Environmental Detectives', learn about the ecosystem searching for clues and gradually revealing the secret. Students in addition to AR use e.g. GPS. In the process

of training crews and land-based personnel of maritime transport there are very often used simulators, which are nothing but a virtual environment. Training of seamen with AR simulators could take training literally into new dimension.

CONCLUSIONS

In the modern navigation and maritime transport it is believed that better decision would be made if based on information received, and not only on intuition and experience. However there can be a situation when data collected from all sources may not be sufficient. Augmented Reality supplements the data collected and presented information about the computer generated virtual objects allowing the user to make the right decision. Contemporary modern maritime transport, seeks the ways to re-evaluate and define the roles of ship crews and shore staff. According to the author seafarers and workers of shore based facilities should be actively involved in the process of shipping. All we have to do is to make better decisions, supported by robust technology.

REFERENCES

[1] Azuma R., *A Survey of Augmented Reality, Teleoperators and Virtual Environments*, August 1997, pp. 355–385.

[2] Azuma R., Baillot Y., Behringer R., Feiner S., Julier S., MacIntyre B., *Recent Advances in Augmented Reality*, 'IEEE Computer Graphics and Applications', 21(6), pp. 34–47.

[3] Filipkowski D., Wawruch R., *Concept of 'One Window' Data Exchange System Fulfilling the Recommendation for E-Navigation System*, Transport Systems Telematics, Springer 2010.

[4] Filipkowski D., *Informatyczne elementy systemu e-Nawigacji*, 'Logistyka', 2011, No 6.

[5] Mann S., *Mediated Reality with implementations for everyday life*, Teleoperators and Virtual Environments, 2002.

[6] Milgram P., *Augmented reality: a class of displays on the reality-virtuality continuum*, Telemanipulator and Telepresence Technologies, Warszawa 1994.

[7] Milgram P., Takemura H., Utsumi A., Kishino F., *Augmented Reality: A class of displays on the reality-virtuality continuum*, Proceedings of Telemanipulator and Telepresence Technologies, 2007.

[8] Pardel P., *Przegląd ważniejszych zagadnień rozszerzonej rzeczywistości*, 'Zeszyty Naukowe' Politechniki Śląskiej, seria: Informatyka, 2009, Vol. 30, No 1(82).

ANALIZA MOŻLIWOŚCI ZASTOSOWANIA ROZWIĄZAŃ ZDEFINIOWANYCH JAKO WZMOCNIONA RZECZYWISTOŚĆ W NAWIGACJI MORSKIEJ I TRANSPORCIE MORSKIM

STRESZCZENIE

Artykuł jest wynikiem prac badawczych nad modelowaniem transferu danych statek--statek lub statek-stacja brzegowa w oparciu o założenia e-nawigacji. Podejmuje próbę przeanalizowania, jak narzędzia zdefiniowane jako wzmocniona rzeczywistość (WR) mogą zostać zaadaptowane i wykorzystane w procesie nawigacji oraz generalnie w transporcie morskim. Koncepcja wzmocnionej rzeczywistości nie jest nowa, zyskała popularność wraz z rozprzestrzenieniem się takich urządzeń, jak PC-ty, tablety i smart fony. Uważa się, że rozwiązania, które rewolucjonizują codzienne życie, mogą mieć wpływ na rozwój nawigacji oraz polepszyć bezpieczeństwo transportu morskiego. Gdziekolwiek istnieje zapotrzebowanie na proste i jasne przedstawienie informacji, tam jest przestrzeń dla WR, która wzmacnia percepcję użytkownika poprzez komputerowo generowane obiekty wirtualne obrazowane w czasie rzeczywistym. Niezwykle ważne dla nawigacji, ale także dla całego przemysłu, w tym dla transportu morskiego, jest to, że obiekty wirtualne pozwalają użytkownikom realizować zadania rzeczywiste. Wzmocniona rzeczywistość jest dzisiaj szeroko używana w takich dziedzinach, jak medycyna, marketing, nawigacja samochodowa, siły zbrojne, bezpieczeństwo, hydrologia i geologia, symulacja i szkolenie, rozrywka i edukacja. Nawigacja i transport morski mają tendencję do pozostawania nieco z tyłu za światowymi trendami. Jest to niezrozumiałe, ponieważ możliwości zastosowania WR w tym obszarze wydają się być nieograniczone.

Słowa kluczowe:

e-nawigacja, wzmocniona rzeczywistość, radiokomunikacja.