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DEVELOPMENT OF VIRTUAL INFORMATION SPACE ON THE NAVIGATION BRIDGE OF THE SHIP

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Introduction. The level of automation of combat operations management processes of modern warships is becoming increasingly important. The theatre of naval operations is expanding and constantly changing. The use of new types of weapons has a significant impact on the choice and implementation of tactical methods of conducting naval combat, and as a result, on the strategy of conducting operations in the maritime zone. The possibility to conducting operations in coastal marine area determines the possibility of using naval ships as one of the components of a combined operation with the solution of the entire mission area of providing combat actions: from fire damage on various targets to logistics support tasks; and from air defense tasks to the tasks of hitting objects at great distances. This leads to the fact that the use of ships requires solving a wide range of tasks for collecting and processing a huge flow of information. Moreover, the flows can be divided into external and internal [1,2]. External flows of information include navigation information in all its diversity, combat information about your forces and facilities and your enemy's ones, regulative documents, meteorological, ecological, hydrographic and any other information [3]. Internal information consists of navigation information, radar data, ship status information, information about the status and readiness of weapons etc.

All the variety of information processed by the ship's control system is used further to assess the situation and make decisions on the management of the ship and the conduct of combat operations by the command staff.

Information richness of decision support processes of the command staff requires an assessment of their abilities to process information, find ways to eliminate redundancy and create comfortable information conditions to make decisions [4].

Currently the whole variety of tasks that have to be solved is being accomplished in different conditions with one and the same set of information models implemented in the form of a single information complex of the ships' battle bridge [5].

This approach reduces the ability to form adaptive information models depending on the current situation and display the necessary information for the tasks to be solved. This leads to a decrease in the efficiency and rapidness of decision-making by the command crew staff and their information awareness.

Overcoming this position is possible by applying new approaches to the construction of an information support system for the activities of the ship commanders and applying new approaches to the information processing implemented on the basis of smart technologies. These smart technologies should be part of existing and advanced automation complexes which in turn are part of automated ship control systems [6–7].

Literature analysis. Currently there are several approaches to create automated systems of ship control. The first one implies partial automation of some management processes. For example, propulsion control, vessel traffic management etc [2].

Another approach provides for comprehensive automation of all processes that ensure the management of all ship systems, including weapons [3].

Both approaches involve the use of various means to display information without the development of the unified information space and even more so the information space of combat.

That's why the topic area for research will be the search for ways to create a unified information space for the command staff to control the ship in various conditions of the situation.

Objective. The objective of this article is the development of approaches to design a unified methodological framework of creation and synthesis of command staff's information environment which will help to make decisions in various conditions.

Main body. Currently automated systems of ship control include fragmented display facilities of individual use showing information about the condition of various ship systems. For example, navigation situation, the status and operating modes of the propulsion system, the state of individual weapons systems, the position of other surface objects etc.

This approach to the creation of display system needs the command staff to constantly be in a state of increased psychoemotional stress. It's required to keep in mind this up-to-date conceptual model about the state of the ship and the environment. This leads to a decrease in the rate of updating the conceptual model and to a decrease in the efficiency and validity of ship management decision-making and responding to changes in the environment.

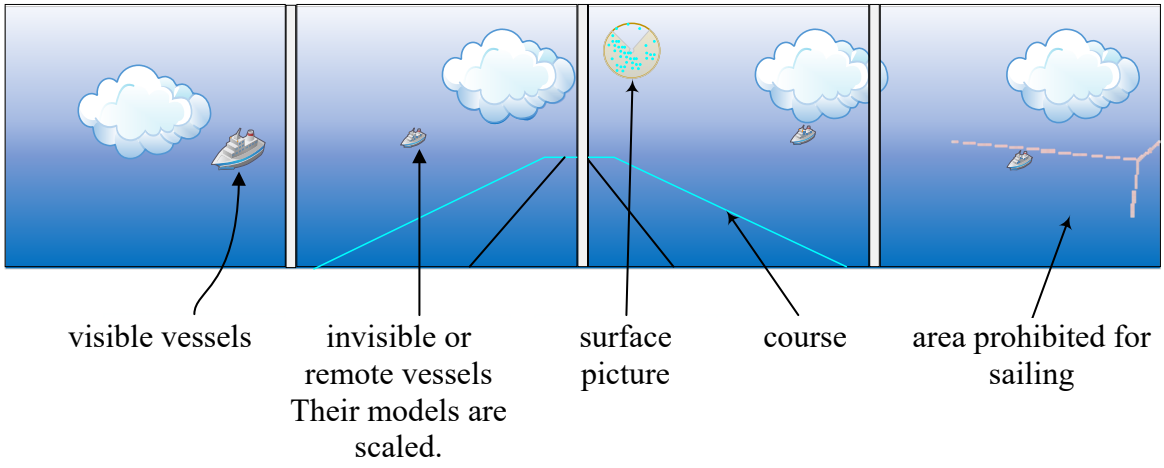
One of the possible approaches to overcome this disadvantage may be Augmented Reality (AR), a technology which can solve this problem in limited conditions for the deployment of information display tools.

Thus, semi-transparent screens can be integrated in illuminators of the bridge. This will help to expand the information field significantly and create a hybrid rendering about both the environment and the condition of the internal systems of the ship.

For the command staff environmental information is the most significant to make decisions. The screens built in the illuminators may display surface picture information, air picture, other ships which cannot be visually seen or their vision is blurred. The pilot information can also be seen, as well as sailing areas with various limitations. For example, it is possible to display the information about the areas prohibited for sailing, state borders, marginal waters, shallow waters, banks and other data.

It is also possible to display the information about the impact zones of various kinds of weapon, interference and other types of conditions.

The example of such a display is given in pic.1.



Pic. 1. A variant of creating an information display system with AR elements

The formal representation of information selection procedures and its display as a part of the information model containing AR elements can be set through a general transition equation for sequential display model transformation [1, 2]:

$$X\left[k+1\right]=\Psi(X,Q,D,t)X\left[k\right]+\Xi\left(t\right)Q\left(k\right)+\Lambda\left(t\right)\Omega\left[k\right], \quad (1)$$

where $X\left[k+1\right]$, $X\left[k\right]$ – state vectors of the object and environment at all relevant times;

$\Psi(X,Q,D,t)$ – transition function which takes into consideration the changing state of the control object;

$Q\left(k\right)$ – control response vector;

$\Omega\left[k\right]$ – the vector of disturbing actions of the environment;

$\Xi\left(t\right)Q\left(k\right)$ and $\Lambda\left(t\right)\Omega\left[k\right]$ – vector integral transform of management and disturbing actions.

This approach also allows to raise situational awareness in the condition of insufficient visibility and keep situational awareness in case of the need to draw armored shutters of illuminators and increase crew survivability in combat. This will have a significant impact on the efficiency of combat operations.

Conclusion

The analysis of current automated systems of ship control has shown the presence of disparate elements which display various kinds of information models which in turn display various elements of the condition of external situation and ship systems. This makes crews spend huge efforts to maintain situational awareness and reduces effectiveness and responsiveness of made decisions. The suggested approach to creation of a unified information space based on AR technology will help to overcome all the mentioned disadvantages and increase the crew's efficiency in various conditions.

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