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Integrated Organization of the System for Forming the Information Support of Aeronautical Simulator

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Abstract

In this article, we consider the complex organization of an airborne simulator information support system. The purpose of the article is to propose a method to provide a semantic structure of information in accordance with the hierarchical structure of the system for problem solving of determining an aircraft model location in a virtual space. Using an intelligent analysis of data received by the pilot from simulators of cabin equipment, using a method "path calculation", and also using a cognitive visual environment synthesized by a visual simulator, radar simulator, thermal camera simulator. The order of use of individual methods of restoring orientation in space is not fundamental. A prerequisite is the acquisition of professional skills, allowing the pilot in real flight to determine the location of the aircraft, learning to solve the problems of navigation tasks.

Keywords: information technologies; cognitive visual environment; data mining; path calculation; restoration of orientation in space.

INTRODUCTION

In developing and analyzing the method of organizing the information support of an aircraft simulator that allows us not only to teach the piloting of an aircraft (Roganov, 2015: 81-87), but also the solution of air pilotage problems (Roganov *et al.*, 2016: 326-328), its main components were identified:

- a database of visual simulators, radiodetector simulator, thermal camera simulator, with information for constructing visually observable models of an actually existing section of the terrain that has fallen into the viewing pyramid (where it is possible to both fly and teach pilots the aircraft control), in real time (Roganov, 1995);
- a map of virtual space with the designation of the radio-technical object models located in it, used to restore the location of the aircraft model in the virtual space according to the data from the radio beacon and SHORAN (Roganov, 2002: 127):
- informational and structural models that formalize the validity of inclusion of certain real objects' models in the visual simulator, radiodetector simulator, thermal camera simulator databases, taking into account the spatial-temporal and semantic structures of a priori and experimental data obtained about them, to provide the possibility of navigation tasks solving for training pilots in the flight on the air simulator (Roganov *et al.*, 2015: 38-45);
- verbal and logical models describing information obtained by the method of expert evaluations in the analysis of object models to be included in the visual simulator, radiodetector simulator, thermal camera simulator databases to create conditions for the solution of navigation tasks in during piloting aircraft (Roganov, 2015: 88-93);
- experimental information obtained from cabin equipment simulators, necessary for solving the problem of restoring

the aircraft model’s location in a virtual environment by the method of "calculating the path" (Roganov, 2014: 80-87);

– technology for obtaining monitoring information allowing to restore the location of the aircraft model in virtual space through intellectual analysis. Including visual search of reference objects’ models visible in the visual, radio and heat ranges; calculating the length of the traversed path and its direction in the virtual space, at the time of determining the location of the aircraft model in virtual space (Roganov, 2015: 7-13);

– data mining technologies of monitoring information that allows to restore the location of the aircraft model in virtual space by calculating the path by constantly reading information from the cabin equipment simulators and postponing the traversed path on the virtual space map.

MATERIALS AND METHODS

As well as determining the location of the aircraft model in virtual space from the observed reference objects’ models (Mamaev *et al.*, 2002: 256);

– algorithm for ranking objects of an external environment selected as a prototype in the virtual space simulation, in order to make decisions about the necessity and sufficiency of their inclusion in a virtual space, to provide the ability to solve on aeronautical simulator not only piloting tasks, but also aircraft control problems (Prokhorov & Kharin, 1995: 113-131).

The purpose of this method is to create an integrated system for creating aeronautical simulator information support and to provide a semantic structure of information that ensures the inclusion of navigation tasks education in the list of training tasks.

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The method of creating an integrated system of information support (Figure 1) includes the synthesis of information support, which allows to include the tasks of aircraft navigation tasks using by synthesizing visually observed:

– map of a space for fly on a flight air plane simulator;

– three-dimensional models of recognizable sections of the earth's surface visible through the glazing of the aeronautical simulator cabin;

– two-dimensional models of recognizable sections of the earth's surface visible on the radiodetector screen;

– two-dimensional models of recognizable parts of the earth's surface visible on the thermal camera's screen;

– synthesis of information in simulators of cabin equipment that allows the pilot to determine the location of the aircraft model in virtual space by the "route calculation" method or by radio beacons;

which in the end provides the possibility of using the technology of the intellectual analysis of the initial data describing the selected models of actually existing objects of the terrain sites chosen as a prototype for flights on a flight air plane simulator.

The implementation of the method of creating an integrated information support system allows pilot to locate the aircraft model in virtual space, which implies the insurance of pilot's ability to navigate:

– on visual images of three-dimensional reference objects’ models visible through the glazing of the cabin and located on the underlying surface of the virtual space;

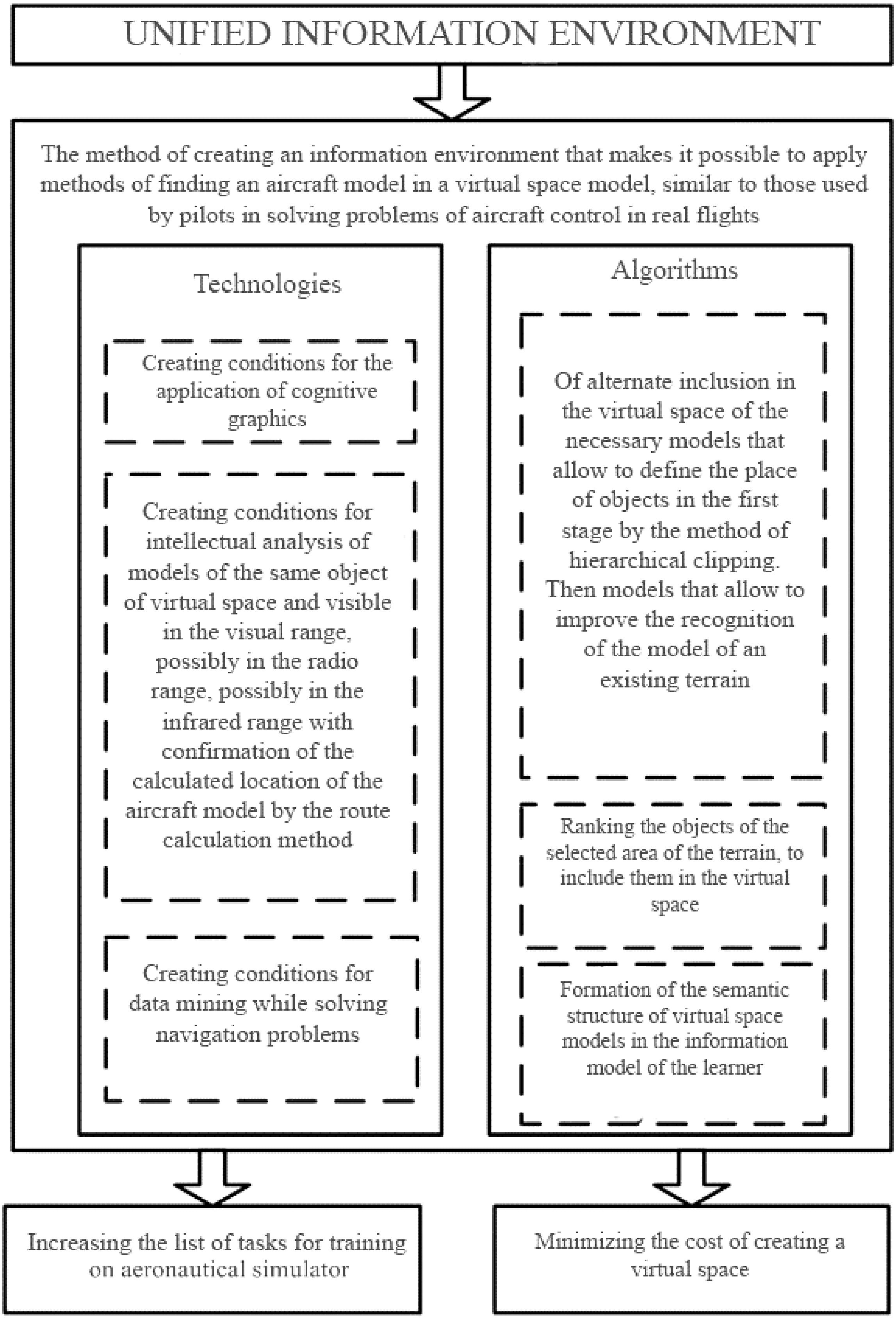

Figure 1: The method of creating an integrated system of information support, allowing you to include the navigation tasks in the list of training tasks for aircraft simulator pilots.

- on visual images of reference objects' models visible on the screen of radar simulator;
- on visual images of reference objects' models visible on the screen of thermal camera simulator;
- according to the information from the cabin equipment simulators and the area model map, which allow using the "route calculation" method;
- according to the information from the cabin equipment simulators and the area model map, which allow to solve problems of air navigation over terrestrial radio beacons.

RESULTS AND DISCUSSION

The solution of these problems involves the use of cognitive graphics to solve aircraft problems. This, in turn, involves the development of appropriate models of the existing terrain for visual simulator, radiodetector simulator, thermal camera simulator which provide the opportunity to teach pilots aircraft control, including the determining of the aircraft model location in virtual space by the "route calculation" method.

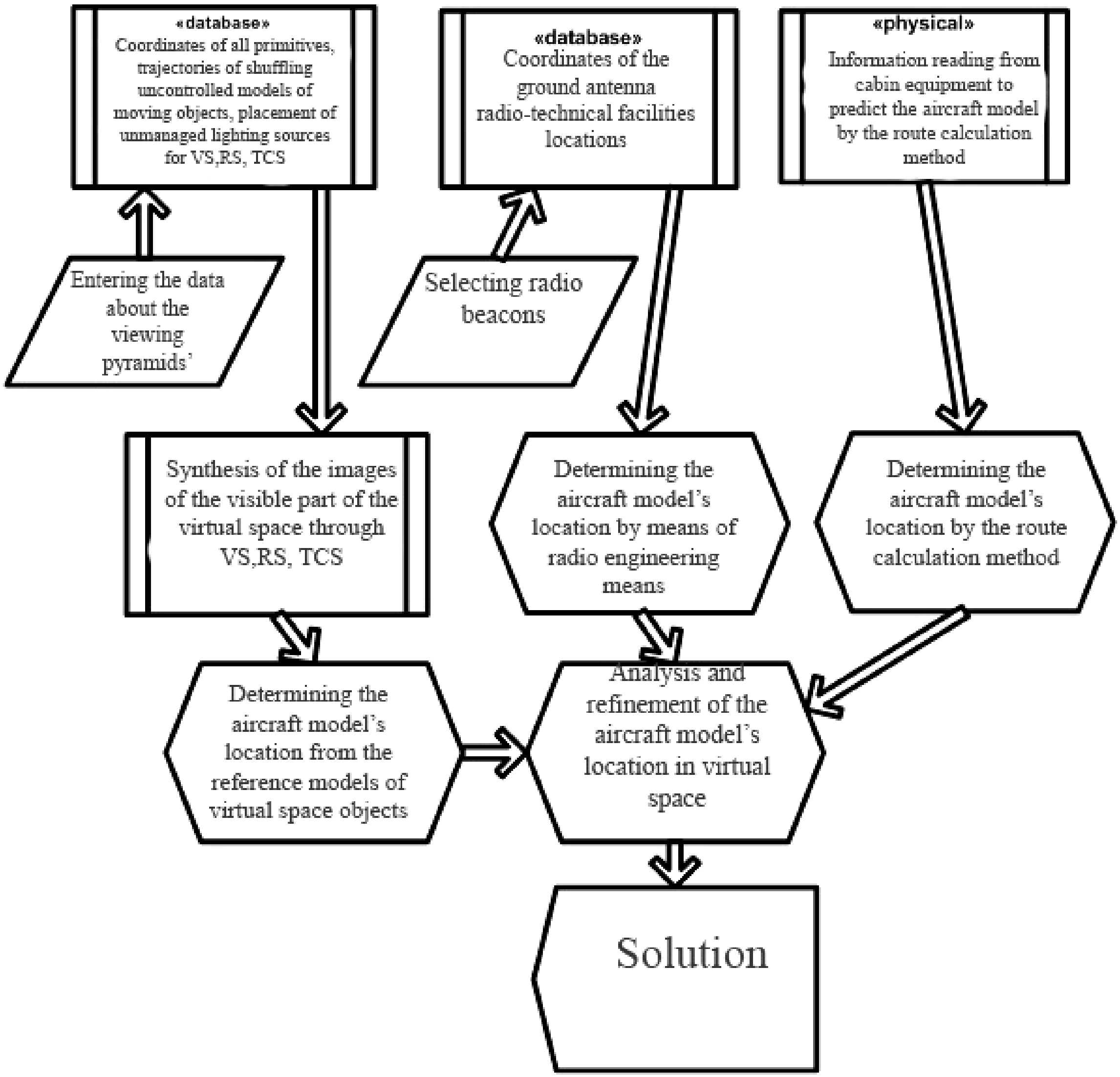

Figure 2: Datamining.

This approach allows:

- to ensure the formation of the semantic structure of the information environment, which allows to make adequate decisions, when learning the navigation tasks using an aircraft simulator;
- to determine the place of the visual simulator, radar simulator, thermal camera simulator, an area model map in the process of making a decision about the

location of the aircraft model in the virtual space, in this structure;

– allow the use of a hierarchical method of selecting the necessary information when the pilot restores the space orientation, taking into account his experience, personal preferences and the adequacy of the information obtained for solving the tasks set. This is provided by the topological structure of the initial information stored in the visual simulator, radiodetector simulator, thermal camera simulator databases determined by methods of its acquisition, processing, holding and retrieval from databases.

Figure 2 presents a scheme of information datamining, arriving to the pilot passing training on AT during the restoration of orientation in space.

The information received by the pilot allows him to determine the location of the aircraft model in virtual space at any time, using same methods and algorithms that he applies when restoring the location of the aircraft in real space (Fig. 3).

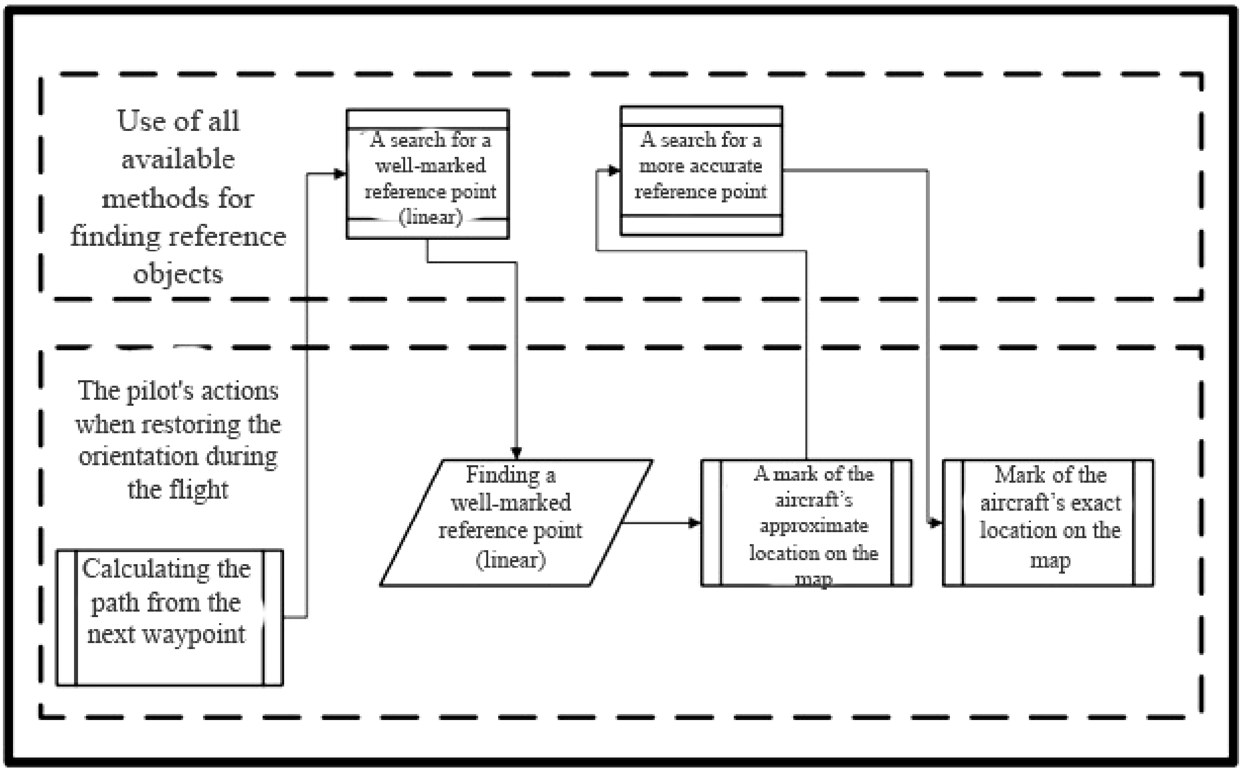

Figure 3: The pilot's actions in determining the location of the aircraft model in the virtual space.

To solve the aircraft navigation tasks on an aircraft simulator, it is necessary to synthesize the virtual space in which the aircraft model can move. Synthesis of such a space is a complex task, solved step by step by aeronautical simulator developers.

Taking into account that it is impossible to synthesize an exact copy of an actually existing terrain's section, the task of synthesizing virtual space is solved based on a Terms of Reference on an aircraft simulator. This task begins with a preliminary stage at which the necessary information is collected, questionnaires for pilots - what objects are necessary for them when performing real navigation tasks on the aircraft. These studies are conducted separately at first. Applied to the problem of synthesizing visually observable models of three-dimensional objects solved with the help of a Visual simulator. As a result, we get:

- a database for a computer image generator of a visual simulator DBv and a virtual space map;

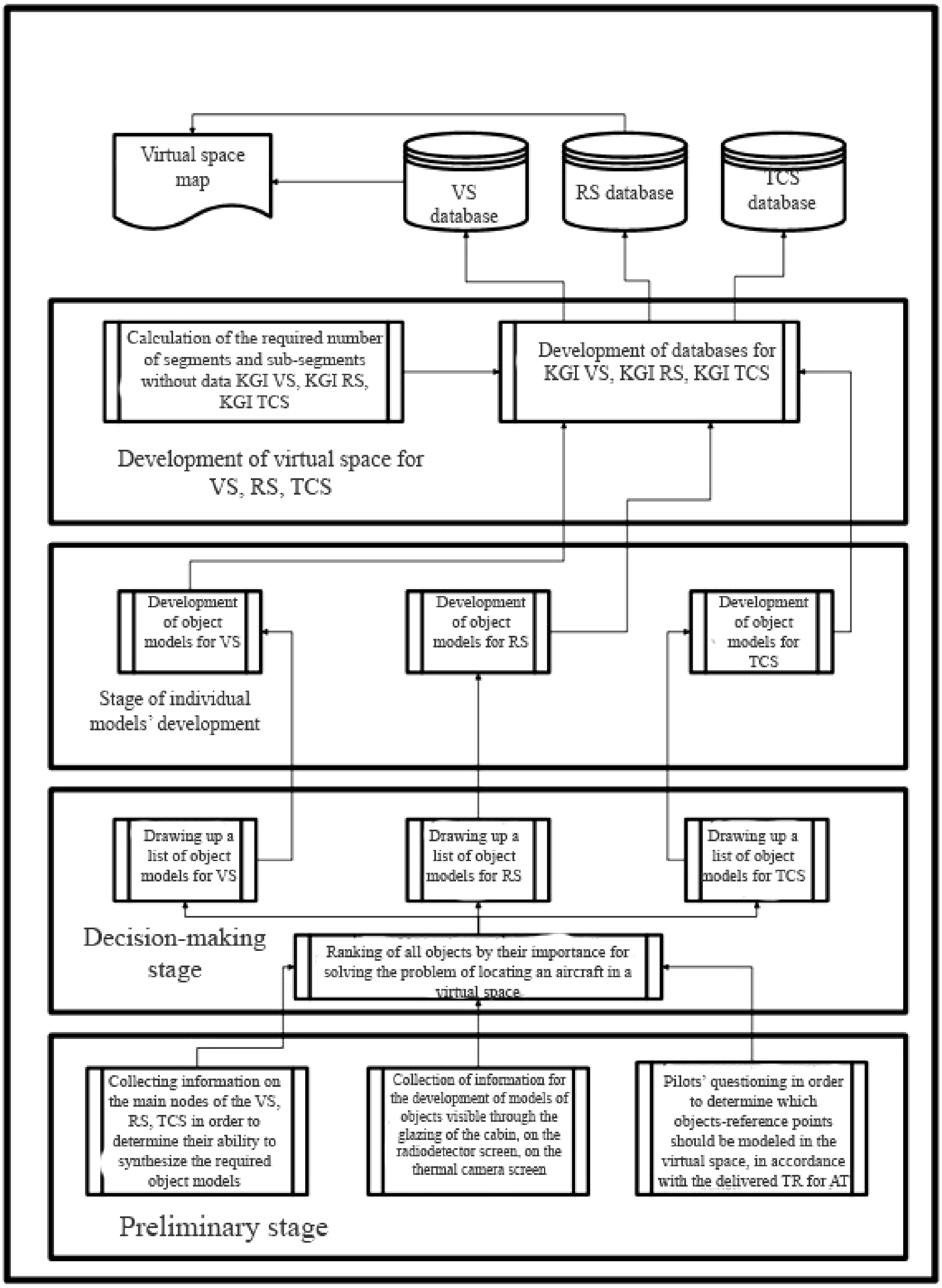

Figure 4: Stages of information preparation for a visual simulator, radiodetector simulator, thermal camera simulator.

- a database for the computer image generator of the radiodetector simulator DBr;
- a database for the computer image generator of the thermal camera simulator DBq.

All information about modeling objects except databases is reflected on the visual space map. The analysis showed that some of the objects' models Mv stored in DBv can be entered with advisory coloring as Mr in database of DBr and also with appropriate shading as Mq in a DBq database. Thus, the set of visualization objects visible on the radiodetector and thermal camera screens are subsets of visualization objects visible through the glazing of the aeronautical simulator cabin.

$Mr \subset Mv$, is a condition which is fulfilled only on a part of the virtual space in which flights on AT are possible. It does not extend to a part of the virtual space that adjoins this site, but flights over which are impossible. But this section is described in the radio doctor database, since it allows to see it on the radiodetector's simulator screen in the appropriate scale.

$Mq \subset Mv$, this condition is always fulfilled.

It is possible when part of Mr_i of the visualization objects visible on the radiodetector screen will not be visible on the thermal camera screen.

CONCLUSION

Thus, the given algorithm of interrelations of objects' models stored in databases:

- computer image generator of the visual simulator;
- computer image generator of the radiodetector simulator;
- computer image generator of the thermal camera simulator;

allows to synthesize the information support system of the aviation simulator, which allows to include the tasks of aircraft control study in the list of training tasks of the simulator.

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