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## **ON - LINE SYSTEM FOR SEAT MAP VISUALIZATION AND PASSENGER SEAT ALLOCATION IN THE AIRCRAFT**

### ***Abstract***

The article presents the basic rules and principles of the organization of seats aboard transport aircraft taking into account their internal arrangement of the board. The authors present a basic conceptual draft of the system for a graphic visualization of seats arranged aboard of the selected type of aircraft as a part of a check-in module being developed for the DCS system for a particular airline company needs. The web-based application of the system supported by the function of allocating seats for individual passengers based on the pre-defined selection criteria in the process of check-in and reservation, was presented. The system can be realized as an integral part of web-based check-in or mobile check-in applications as well as on-line self-check-in systems for seat reservation and allocation aboard of an aircraft, as a part of the ground handling process at the airport.

**Keywords:** seat map, seats organization, seats' allocation, web application, check-in.

### **Introduction**

There are few areas of the human activity which are dependent on the information technology and civil aviation is one of such areas. It is hardly when an airline or travel agency is capable of providing air transport services without using the modern applications of the seat reservation systems. The modules for seats allocation create the modern applications. As regards seats' arrangement, there are legislative recommendations or regulations that refer to the area of air transportation.

The main goal was to develop an online application for a graphical visualization of the seat arrangement for a selected version of passengers aircraft. The system of seats' allocation designed is expected to facilitate assigning a specific seat to the passenger or a group of passengers. In terms of implementation, the proposed solution is based on the currently used programming languages and techniques for creating online web applications offering independence for a user of a hardware platform. The efforts

resulted in the program tool which significantly accelerates and facilitates the process of allotting seats for passengers.

### **On - line systems for seats' allocation**

Airlines and civil aviation are aware of the benefits of the development of information technology and are in the process of rapid implementation reflected in the process of seat reservation and allocation for their passengers. With the development of internet technologies, on-line sales systems become one of the main sales channels for the sales in air transportation.

Due to making bookings *via* an online reservation system, seats can be automatically assigned to the passenger in the chosen class out of the currently available seats without charging an additional fee. The possibility of booking specific seats in air transport constitutes ancillary services. The most conventional airlines connected to the GDS enable choosing a specific seat free. Due to the constant updates, they are starting to make these services payable as it is a common practice used in low-cost airlines. The choice of a seat is realized either within the reservation system or directly at the airport ground handling. The site-selection through DCS at the airport has its withdrawals especially when typing a specific seat number, currently representing a fairly outdated method. This was the reason of developing further systems for the seat allocation as described below [4].

### **The principles of seat organization**

Seat organization is based on the principles established by both national and international recommendations. In Europe, the applicable regulations are included in the CS-25 document. For the US aircraft, the principles established in FAR Part 25 document are considered as being applicable. The number of seats on board is determined by two requirements. The first is the compliance with airworthiness regulations while the second one is based on commercial considerations. The fleet's planner has to be based on the schema, recognized as a layout of passengers' accommodation (LOPA) [2].

In the Slovak Republic, the applicable document JAR-OPS-1 contains recommendations for a seating allocation. There are also some rules concerning passengers who have some restrictions or health problems. These passengers are not allowed to seat in the rows leading to an emergency exit [3].

### **Development of the technology for on - line applications**

The entire process of the development involved the use of the current programming languages and the library for the development of on - line applications development such as HTML, CSS, JavaScript and PHP. The HTML language is the predominant markup language used to describe content, or data on the World Wide Web. HTML5 is the latest iteration of that markup language and includes new features. Nowadays, the HTML5 represents a kind of a standard for the development of on - line applications. It was the main reason why this language was used in the practical part. CSS is a shortcut for Cascading Style Sheets. It is a style-oriented language that describes how HTML markup is presented or styled. The latest version of the CSS specification is known as CSS3 [1]. Currently, the JavaScript language is the most powerful and widely used programming language for web development. In general, it is

used for a user interaction with a web application. The practical solution was to make the use of the jQuery library free and actually very common JavaScript library designed to simplify the client-side scripting of the HTML. For a database interaction, the PHP programming language PHP was used, as it is the most popular scripting language on the server side for web applications development.

### **On - line systems stages of design and implementation**

The implementation stage mostly concerns web-based applications visualizing seat- map of selected airplanes and the possibility of choosing a place for passengers.

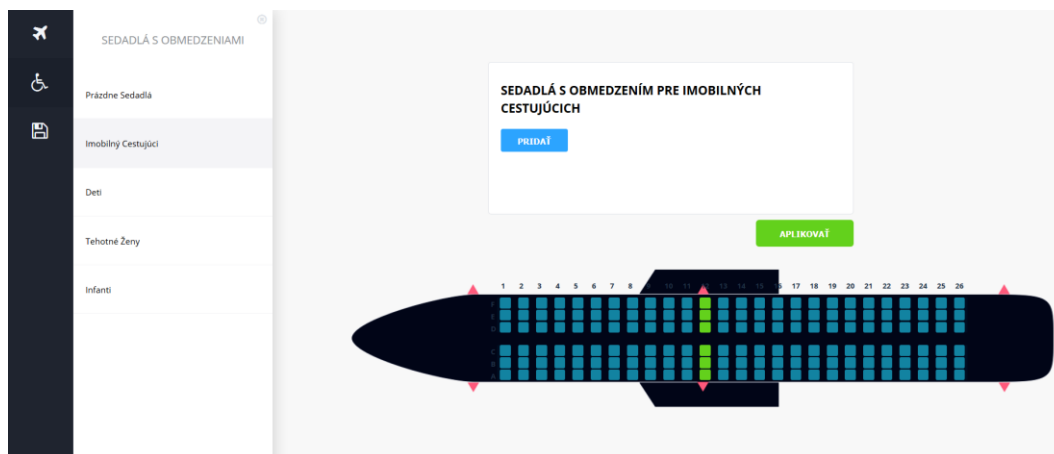
#### ***Stage of design***

The design of practical solutions will be based on the transparent and intuitive use of user interface (UI) so that the layout of individual components will induce the user's involvement. The system will be divided into three separate HTML documents. The first one is a "seat map-maker.html" used to draw-up the seat-map itself. The device allows to create seat map after filling in values for the number of rows and number of seats, and after rendering of the seat map, it is allowed to add restrictions for individual seats. The seat map generated will be subsequently stored in the database.

Applications for the allocation of places are based on the principle of selecting a passenger subsequently assigning points to that passenger. Such applications enable to deal with a group of passengers easily, saving the changes into the database. Both applications require timeliness of data, consequently, they are to be implemented in a cycle with the requirement of updating the seat map data of seat availability and the type of its restrictions for passengers.

#### ***System of seat map visualization***

The application for seat map visualization is mainly aimed at providing the ability of generating a seat map based on the user's data including: the number of classes, the number of rows and seats in each row. After starting the web application, the user has two main options: First, he or she can choose out of the ready-made seat maps on the basis of the data which is stored in the database table. The second option refers to developing a new seat map based on the user's data. The user selects for a seat map using the data stored in the database by applying AJAX methods. It makes the use of all the necessary data for a "generate seat map" function, and as a result, a seat map is generated. In case of a user selecting the other button set for creating its own seat map, the first step involves choosing a background for the HTML elements, subsequently representing classes, rows and seats. The background is the illustration of airplane fuselage layout and it is possible to choose narrow or wide fuselages. The next step is checking classes contained in the seat map. After selecting classes, the value can be set which represents numbers of rows and the number of seats for each row. Then, the program performs small validation and a check of all the selected classes containing the inputs set. If everything is performed properly, a button for seat-map generation will appear. By clicking on the button, a "generate seat map" function is activated to generate all the HTML elements for the seat map. Users still have the opportunity to change the background or the values.



**Fig. 1. Seat map visualization**

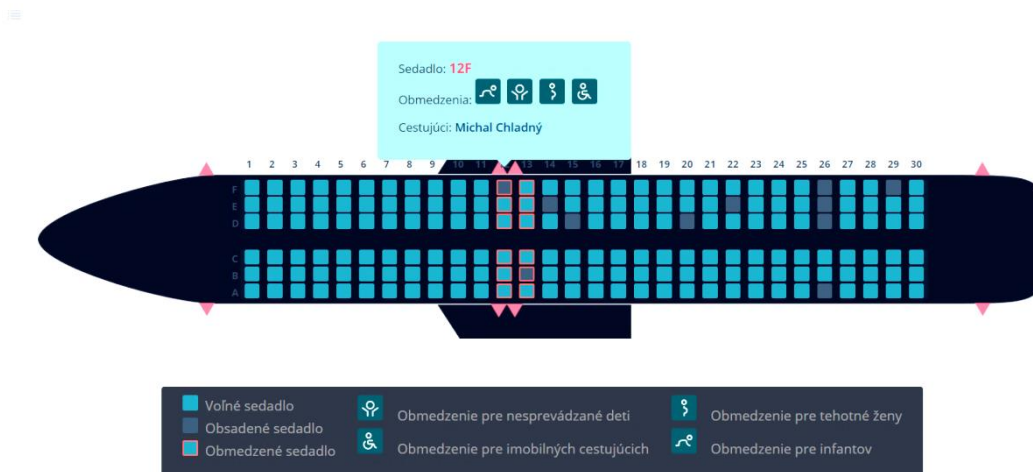
*Source: author's own material based on Tabačko, Adam. Online systém pre vizualizáciu rozmiestnenia a pridelovanie sedadiel pasažierom vo vnútri dopravných lietadiel. Bakalárska práca. Košice: Technická univerzita v Košiciach, Letecká fakulta, 2016. pp 61.*

After developing the seat-map, the user has an option to add some restrictions and empty spaces for defining seats by adding some information. When defining seats with some restrictions, the user has to select a category of users. A new panel with the category name along with the "add" button will appear. Clicking on this button, the user can select seats which by making another mouse-click will show restriction for the category selected. The final step concerning the web application involves saving the seat map in the database table. In order to complete it, the user needs to specify the name of the version of the seat map generated by pressing the "save" button.

### ***System of seat allocation for check-in***

One of the main applications for allocation of seats is achieved *via* a web based application which allows the check-in agent to select a seat from the displayed seat map and assign it to a specific passenger. The application also enables the check-in agent to select a seat for a specific person out of all the passengers included in the group. As a consequence, the group is handled more effectively.

While opening the application, the check-in agent has to select a seat for a flight from a select dialogue box. All information on the specific flight is stored in the "flight" database table. After selecting the flight, all necessary data regarding all passengers and information on the passengers, and seat map data for "generate seat map" function are sent from the database by AJAX requests into a specific PHP document. All the passenger's data from the selected flight is then returned by a PHP document in a JSON format, including the array of objects. Each object is specified by one passenger. Such information includes an ID, a first name, a surname, a category of passenger, an actual seat, a group's name and a reference to another passenger, a flight and reservation number. All passengers are visible in a side menu and they are divided into categories. Important information regarding the passengers is stored into the data attributes in a specific HTML objects. All relevant information for check-in agent is contained in the seat map. All seats occupied are showed and marked in a dark blue color. All restricted seats have red lining around. After clicking on any seat, the agent is able to see the passenger who actually booked or selected the seat or what category of restriction is assigned to the occupancy of the seat.



**Fig. 2. Tooltip with a name of the passenger and restriction information**

*Source: author's own material based on Tabačko, Adam. Online systém pre vizualizáciu rozmiestnenia a pridelovanie sedadiel pasažierom vo vnútri dopravných lietadiel. Bakalárska práca. Košice: Technická univerzita v Košiciach, Letecká fakulta, 2016. pp 61.*

If a check-in agent wants to focus on a specific person, the passenger has to be checked in the side menu. After making the check, the agent can work with the traveller by clicking the mouse button on the passenger. All the necessary information is displayed in a central panel. In case when the passenger is related to another person on board, for example, an adult with an infant, the information on the baby is also displayed. When selecting a passenger belonging to a group, the rest of the group members are also displayed in the central panel. Important information about the selected passenger also includes a category which is displayed under his name and surname.

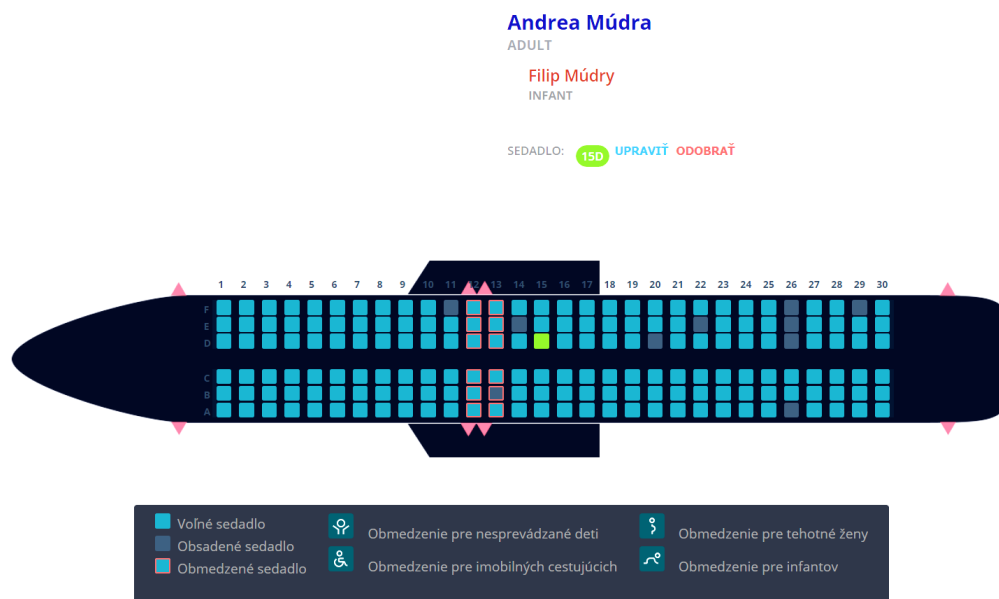
The check-in agent has three main options. The first option involves seat selection when the actually displayed passenger does not have a seat. In this case, the "addSeatSinglePax" function for seat allocation is called. The second option is when the passenger has a seat assigned. The agent can change this seat by clicking on "change" and calling the "addSeatSinglePax" function, or removing the actual seat by selecting for the "remove" option. The "addSeatSinglePax" function belongs to a general part of this application. It allows the agent to select a seat by clicking on rounded square HTML elements in a seat map which represents seats. If the seat selected has a restriction for a passenger actually handled or the seat is booked by another passenger, a red warning info is displayed under the center panel. If there is no limitation for a passenger or an infant, the seat number is displayed in a center panel and the button for saving this selection appears under the panel. The agent still has the possibility to choose another seat. After clicking on the save button, the "saveSeatSinglePax" function is called. The main purpose of this function is to execute part of the program, which checks whether the selected seat is still free or booked. In order to complete it, the AJAX request to PHP code is called which returns to the actual list in the data array format containing all seats booked. After comparing the selected seat with the array, the AJAX request is called for saving the seat to a specific row of the "passengers" database table with the ID which belongs to the passenger. On the other hand, if in the meantime the selected seat has already been booked, a warning info will appear and the check-in agent has to select another seat [5].

If the agent is dealing with a group of passengers, the options are the same as in the previous case. For selecting or changing a seat, the "addSeatGroupPax" function is called. This function allows the agent to click on seats and select the seats with no restriction for the passenger actually handled. At the same time, seats to passengers from a group are added using "groupSeatObj" containing all the data including passengers' IDs and their seats [5].

Unlike the allocation for a single passenger, the "save" button used for saving seats to all passengers from the group will appear only after having all the checked passengers their seats allocated. Clicking on the "save" button, the "saveGroupSeat" function is activated. It compares all the data from an array of the actually booked seats with those of the "groupSeatObj". If there is no consistency between the data, then all seat numbers for the individual passengers are stored in the database. For instance, they are allocated to the passengers and the seats are marked as occupied [5].

### Seat allocation in the process of reservation

The application for passenger's seat allocation constitutes an important part of the on-line reservation system process. The users of this application are passengers who have the opportunity of making the use of on-line web application for easy choosing a seat from a displayed seat map as a part of the reservation function. When opening the web application, the passenger can view the input field pushing the "open" button. The whole process of selection starts by a reservation of a number of passenger. The main part of this application consists of an allocation of a seat. The user has two main options depending on whether the passenger has a seat or not.



**Fig. 3. An Infant and an adult passenger in a center panel**

Source: author's own material based on: Tabačko, Adam. Online systém pre vizualizáciu rozmiestnenia a pridelovanie sedadiel pasažierom vo vnútri dopravných lietadiel. Bakalárska práca. Košice: Technická univerzita v Košiciach, Letecká fakulta, 2016. pp 61.

If an actual passenger does not have a seat, he can choose by clicking on the "select seat" option. On the other hand, when a passenger has a seat, he can choose another one by selecting for the "change" option. If a single passenger is handled, both options make the use of the same "addSeatSinglePax" function. Its main purpose is to add a mouse click option to all seats which have not been booked yet.

Now, the passenger can choose a seat which is not booked, and the restrictions of the selected seat satisfy the passenger's category. If there is some restriction for the selected seat, a warning info is displayed under the panel as a note for the passenger to choose another seat. After selecting the right seat, the "save" button is displayed. After clicking on this button, the process is the same as the check-in web application. Before saving the seat number into the database table, the application compares the actually booked seat with the one selected by the passenger, and then seat number is saved into the passenger row table.

The process is very similar while handling a group of passengers. After typing in the reservation number referring to the group, names of all passengers from the group are displayed in the central panel. The users can select different names of passengers by clicking on them and then proceed with the selected one. Options for passengers are the same as for the single passenger category. If the passenger has a seat, the user can select for the "change" option. If the passenger does not have a seat, the "select seat" option is still available. By selecting one or other option, the same function "addSeatToPaxFromGroup" is called. The function, as in the previous case, adds a mouse click option to all available seats and presents a make graphic seat map for an interactive user seat selection. When a seat is added to the passenger from a group, an ID and seat numbers are added to the new object, where all data on the passenger from group is collected. When all passengers of the group received seats, the user can save the data into a database table. In the "save" function, the same process is performed as with a single passenger when the actually booked seats are compared with the seat numbers from a group (object).

## **Conclusion**

The main aim was to develop a program tool allocating seats for passengers during check-in or reservation process when the user is provided with the possibility of choosing a seat from an interactive seat map. Providing passengers' information and the possibility of choosing their places is an important feature which contributes not only to improve services for carriers but also increase the overall comfort of passengers by providing them with the opportunity to use seats that fulfill their expectations. The user can choose out of the classes included in the seat map and given the positions of seats within the class. The system can provide the check-in staff or passengers with a two-dimensional authentic view of the board of the aircraft that the flight will be performed on.

The system of passengers' seat allocation was implemented within the check-in process in order to improve the efficiency of the check-in agent. It is a transparent tool which both complies with the task's requirements and is independent of the hardware platform of the user. The agent is offered the exact data on the actually occupied seats and it enables an easy choice of a seat for the passenger being handled along with the further information as regards the location of the seat aboard of the aircraft, or, in case of a group, assigning seats for group members close to one another.

Another important feature of the system refers to generating a seat map, also considered as a contribution to visualization of the internal arrangement of seats aboard

of passenger aircraft. Through the web application creating a seat map, the user is provided with an accessible, simple and transparent tool due to which he is able to generate a diagram of the internal arrangement of seats.

The huge effort has been made in the field of the further improvement of the application as regards the development of other types of modules which are directly related to the passengers' handling process. The example is the automatic passenger seating used in the application for self-service check-in kiosks.

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