# US-4954818-A Multi-window display control system

(1) BACKGROUND OF THE INVENTION  
(2) The present invention relates to a data display control system in a raster-scan-type display device having a frame memory, and more particularly to a data display control system wherein a plurality of data are displayed simultaneously on a display surface of one display device so as to constitute a multiplex display surface.  
(3) In recent years, interactive operation using a display device has become a significant part of personal computer processing as well as various other instruments designed for processing data. In such situations, the simultaneous display of a plurality of data onto one display device becomes an important problem to solve in order to make the operation of such instruments by a user easy and efficient. Various companies of Japan and foreign countries have offered solutions to this problem. A specific example of a multi-window display control system is described in detail in Gregg Williams, "The Lisa Computer System", BYTE, Feb. 1983, p. 33-50.  
(4) In systems similar to the Lisa computers, multi-window display control systems, a major disadvantage is how efficiently the overlapped state of the display areas during the output of display data is controlled, and how rapidly the overlapped state is processed during operation of the display areas and the display data. For example, a common method is that overlapped parts between a new display surface (window) and a plurality of existing display surfaces (windows) are saved per each window. In this method, comparison calculation of coordinate positions of each window frequently occurs, and the number of data transfers for save or recovery increases thereby control of the save state is difficult.  
(5) SUMMARY OF THE INVENTION  
(6) An object of the invention is to provide a multi-window display control system wherein a plurality of data are overlapped and displayed simultaneously on one display device, and when the display positions are mutually changed redisplay or save of the overlapped part can be realized most effectively.  
(7) Another object of the invention is to provide a multi-window display control system wherein when a plurality of data are overlapped and displayed simultaneously on one display device, the priority for display can be fixed and the display of new data can be suppressed until the prescribed operation is finished.  
(8) Another object of the invention is to provide a multi-window display control system wherein when a plurality of data are overlapped and displayed simultaneously on one display device, even if the display position relationship of each display data is changed, only data displayed on the front window can be made the data input object.  
(9) In order to attain the above objects, the invention is provided with a first save area installed in a frame memory for temporarily saving the overlapped part of display data, a second save area installed in a memory area for communication between a display device and a central processing unit, a third save area installed in an external memory if necessary, and a first control table for controlling display position of data, the priority of display between data and the save area during the overlap regarding each of a plurality of display data stored in the frame memory. Wherein a display processor controls the display of the plurality of display data using the first control table, the first, second and third display data save areas, and the frame memory.  
(10) Further in the invention, the display data are controlled and separated into general data and special data such as emergency message or menu command, and the first save area is controlled and separated into a save area of display data overlapped by the special data and a save area of display data overlapped by the general data. Regarding the saving of general data, when the first save area on the frame memory overflows the second save area is used, and when the second area further overflows the third save area installed in the external memory is used. The first control table controls the display position of data on the display device and the priority for display per each display data. If the data are overlapped, the whole data relating to the display are saved in any of the save areas and controlled. The most efficient processing is performed when the position or content of the display data is changed.  
(11) In the invention, data such as menu command or emergency message is different from ordinary data and nearly formalized in itself. Moreover, since a good response property of the display is requested and the priority for display is always the highest, such data is distinguished from ordinary data and called special data. On the contrary, ordinary data is called general data. Corresponding to the calling, in the invention, a window representing the special data and a save area of the display data hidden by this are called special window and special save area or buffer respectively. A window representing the general window and general save area or buffer respectively.  
(12) In the invention, regarding each of a plurality of display data stored in a frame memory, in addition to the first control table to control the display position of data and the priority for display between data, a second control table is installed so as to control the task number and the window reservation setting regarding the display data of the highest priority among a plurality of display data and further the wait queue for display request.  
(13) When the task of display data of the front surface can set the window reservation and the window reservation is set to the second control table and other task newly requests the display or the priority for display of the existing data is changed, if the window reservation setting in the second control table is checked and the window reservation is set, wait state occurs to the wait queue for display request in the second control table and the display request or the display changing request is suppressed, thereby the operator while task updating the display data at the front surface can execute the processing without any interference from other data display task.  
(14) Further in the invention, a third control table is installed so as to control the wait queue for input completion, the wait queue for privileged input request and the current input mode data. The first control table controls the input mode data regarding each display data.  
(15) That is, only the data input request from the first task of the display data at the front surface can be received and the input mode data of the received input request is set to the third control table and the wait queue is formed in the third control table so that the first table waits until the input completion. When the second task, with the display data not being in the front surface, requests data input, the input request is not received but the wait queue for privileged input request is formed in the third control table so that the second task waits until the display data regarding the second task is displayed at the front surface.  
(16) When the position relation of the display data is changed and the display data being not in the front surface is newly displayed at the front surface, the queue arrangement in the first control table and the task number of the display data at the front surface in the second table are changed, and the input mode data controlled by the third control table is saved to the first control table regarding data displayed at the front surface until that time. If the wait queue for input completion exists then, the wait state is changed to the wait queue for privileged input request. If the third task with data displayed newly at the front surface is contained in the wait queue for privileged input request, the wait state is changed to the wait for input completion and the input mode data regarding the third task saved to the first control table is resumed in the third control table. In this condition, only data displayed at the front surface can be always inputted.