

Pager with Display

5. Background of the Invention

The present invention relates to a radio pager (to be referred to as a pager hereinafter).

A pager or a radio selective call receiver is very popular as a convenient device for allowing transmission of call information to a remote user carrying the pager or the radio selective call receiver.

In recent years, a pager with a visible display for displaying information to a user has been developed.

Fig. 1 is a perspective view showing the outer appearance of a pager having a display function. This outer appearance can be employed in the present invention as well as in the conventional pager.

Referring to Fig. 1, a pager 70 comprises a main body 71, a display 72 arranged in the upper portion of the main body 71, and a clip 73 mounted on a side surface 71a of the main body 71. The clip 73 comprises a plate having upper and lower projections 73a and 73b and is pivotal about a shaft 73c extending in the upper projection 73a in a direction indicated by an arrow 74. The lower projection 73b is biased and retracted in a direction toward the side surface 71a of the main body 71. The pager 70 having the structure described above is attached on a waistband of a

user through the clip 73 or in a breast pocket of a coat. Display information on the display 72 can be visually checked.

When the pager is inserted in the breast pocket
5 of the coat, the main body 71 is put into the pocket and the clip 73 is exposed outside as if a pen is held in the pocket. As is apparent from Fig. 1, the display information (numerals in Fig. 1) observed by the user when the pager is attached to the waistband is observed upside
10 down when the pager is attached to the breast pocket. A carrying position of the pager varies depending on seasonal changes of clothes, physical features of the user, and gender. It is thus desirable to allow any user to readily read the display information at anytime regardless of the
15 different attachment positions. The conventional pager cannot satisfy the above needs.

Summary of the Invention

It is an object of the present invention to provide a pager with a display wherein display information
20 can be readily read by any user regardless of pager attachment positions.

A pager as described below
comprises means for receiving a radio frequency signal modulated by at least a radio selective call signal and a
25 display information signal, display means for displaying visible display information corresponding to the display information signal, control means, connected to the display

means, for changing a display direction of the visible display information, and operation means, connected to the control means, for designating the display direction.

Brief Description of the Drawings

5 Fig. 1 is a perspective view showing an outer appearance of a pager with a display;

 Fig. 2 is a block diagram showing a circuit arrangement of a pager with a display according to an embodiment of the present invention;

10 Figs. 3A to 3E are timing charts for explaining the operation of the pager shown in Fig. 2;

 Fig. 4 is a detailed block diagram of a message data processor in the circuit shown in Fig. 2;

15 Fig. 5 is a detailed block diagram of a display controller in the circuit of Fig. 2;

 Fig. 6 is a flow chart for explaining the operation of the circuit shown in Fig. 2; and

 Figs. 7A and 7B are views showing display contents according to the present invention.

20 Detailed Description of the Preferred Embodiment

 An embodiment of a pager will now be described with reference to the accompanying drawings.

 Fig. 2 is a block diagram showing a circuit of a pager according to an embodiment of the present invention.

25 Reference numeral 1 denotes an antenna; 2, a receiver; 3, a wave shaper; 4, a decoder; 5, a programmable read-only memory (to be referred to as a PROM hereinafter) for

storing a self selective call number; 6, a message data processor; 7, a buffer; 8, a speaker; 9, a display controller; 10, an LCD (Liquid Crystal Display); and 11, a crystal oscillator for generating a timing clock for the decoder 4. A ringing stop switch S0 stops producing a ringing tone at the speaker 8. An LCD display reset switch (to be referred to as a reset switch hereinafter) S1 continuously partially displays a message if the message is longer than the overall length of digits of the LCD 10. A display direction change switch S2 is used to change the display direction of the LCD 10.

The operation of the pager having the arrangement shown in Fig. 1 will be described with reference to Figs. 3A to 3E. A desired radio signal received by the antenna 1 is received and demodulated by the receiver 2. The modulated signal is shaped by the wave shaper 3. An output signal from the wave shaper 3 is a digital signal D, as shown in Fig. 3A.

The signal D comprises, for example, a sync signal (e.g., a 62-bit signal) P, a frame sync signal (e.g., a 31-bit signal) SC, an address signal (e.g., a 31-bit signal) A, a message signal M, and a stop signal (e.g., a 31-bit signal) E. When the digital signal D is input, the decoder 4 performs bit synchronization in response to the signal P having an alternate logic "1" and logic "0" pattern. The decoder 4 then detects the subsequent frame sync signal SC shown in Fig. 3C. Upon

detection of the frame sync signal SC, the decoder 4 reads out data from the PROM 5 in which the self selective call number is stored. The decoder 4 then compares the address signal A shown in Fig. 3E with the data read out from the PROM 5. If a coincidence between the address signal A and the readout data is established, the decoder 4 accesses the message data processor 6 through a signal line 12 (Fig. 2) to cause the processor 6 to process the subsequent message signal M shown in Fig. 3E. The decoder 4 then waits for the stop signal E (Fig. 3D) representing the end of message processing.

Upon detection of the stop signal E representing the end of the message signal M, if the self selective call number coincides with the address signal A, the decoder 4 drives the speaker 8 through the buffer 7 to page the user who carries the corresponding pager. The user can stop ringing tones by the ringing stop switch S0.

The message data processed by the message data processor 6 is displayed as a message on the LCD 10 under the control of the display controller 9. In this case, when the user turns on the reset switch S1, a long message can be partially and sequentially displayed in units of display lengths of the LCD 10. When the reset switch S1 is turned on while the final portion of the long message is displayed on the LCD 10, the displayed message portion disappears. When the display direction change switch S2 is

turned on while the message is displayed, the display direction of the LCD 10 can be changed.

The message data processor 6 is arranged, as shown in Fig. 4. Referring to Fig. 4, reference numerals 101 and 102 denote input ports, respectively; 103, a serial interface; 104 and 105, output ports, respectively; and 110, a data bus. Reference numeral 120 denotes a program counter; and 130, a program memory from which the contents at the address designated by the program counter 120 are read out. Reference numeral 140 denotes an ALU (Arithmetic and Logic Unit) for performing various operations such as arithmetic and logic operations; and 150, an instruction decoder for decoding data read out from the program memory 130 and supplying a control signal corresponding to the instruction to the components of the pager. Reference numeral 160 denotes an accumulator used for data exchange among the ports 101 to 105; 170, a RAM for storing various data; and 180, a system clock generator for determining an execution instruction cycle time.

The display controller 9 is arranged, as shown in Fig. 5. Reference numeral 290 denotes a serial interface; 280, a command/data register; 270, a command decoder; 260, a data pointer, 240, a first segment decoder; 250, a second segment decoder; 230, a data memory; 220, an LCD data latch; and 210, an LCD driver.

Data transfer between the message data processor 6 and the display controller 9 will be described. The

message data processor 6 sets a signal line $\overline{CS}$ to low level. The display controller 9 is set in the data input mode. The signal line $\overline{CS}$ is set at high level when data is displayed. The message data processor 6 sequentially
5 outputs a command and data from a signal line SOUT. The transfer timing is determined by a signal from a signal line $\overline{SCK}$. At this time, the message data processor 6 sets a signal line C/ $\overline{D}$ at high level for the command and low level for the data so as to cause the display controller 9
10 to discriminate the command from data.

The serial interface 290 receives a serial signal from the message data processor 6 and supplies it to the command/data register 280. When a command is input to the command/data register 280, it sends the contents to the
15 command decoder 270. The command decoder 270 decodes the command and controls the command/data register 280, the segment decoders 240 and 250, and the data pointer 260 in accordance with the decoded contents. When the data is input to the command/data register 280, data is output to
20 the segment decoder 240 or 250 designated by the command decoder 270. When the segment decoders 240 and 250 receive data, the input data are respectively converted into display codes for displaying information upside down (i.e., the display directions of the normal information and the
25 converted information are 180° apart from each other). The segment decoder 240 or 250 is designated by a command, and the display direction of information can be changed. The

display code output from the segment decoder 240 or 250 is stored in the data memory 230. The stored data is output to the LCD driver 210 through the LCD data latch 220. The LCD driver 210 causes the LCD 10 to display the message in accordance with the display code read out from the data memory 230.

The display direction change in display message, i.e., the inversion function, in the message display mode will be described with reference to the block diagrams in Figs. 4 and 5 and a flow chart in Fig. 6.

In step S1, the pager has already received the message, the message has been input to the RAM 170 in the message data processor 6, and the message data processor 6 is ready for outputting the data to the display controller 9. In step S2, the message data processor 6 determines the ON/OFF state of the display direction change switch S2 in accordance with the input signal from the input port 102. If the switch S2 is OFF, the flow advances to step S3. The message data processor 6 outputs a command SD1 for designating the segment decoder 240 to the serial interface 103. The flow advances to step S5. However, if the switch S2 is ON, the flow advances to step S4. In this step, the message data processor 6 supplies a command SD2 for designating the segment decoder 250 to the serial interface 103. The flow then advances to step S6.

In steps S5 and S6, the command and message data entirely displayed on the screen of the LCD 10 are supplied

from the RAM 170 to the display controller 9. However, the operations in steps S5 and S6 differ from each other in the following point. One character of the message data corresponds to one address of the RAM 170. The character string of the message is stored at addresses from the start to the end addresses of the RAM 170. In step S5, when the command SD1 is generated, the message data is read out from the memory area at addresses from the start address to the end address of the RAM 170. However, in step S6, when the command SD2 is generated, the message data is read out from the memory area at addresses from the end address to the start address.

The above operations aim at preventing the following disorder of the character string. If the message display direction is changed using two segment decoders 240 and 250, the display direction is changed in units of characters. When a plurality of characters of a message are displayed on the LCD 10, the order of the character string is reversed.

In step S7, the display controller 9 discriminates the command from the data supplied from the message data processor 6 in accordance with the signal sent through the signal line C/ $\bar{D}$. If the input signal is a command, the command is sent to the command decoder 270. However, if the input signal is data, the data is sent to the segment decoder 240 or 250 designated by the command decoder 270. If the input command is the command SD1, the

command decoder 270 sends an instruction to the
command/data register 280 to supply the data to the segment
decoder 240. However, if the command is the command SD2,
the command decoder 270 sends an instruction to the
5 command/data register 280 to supply the data to the segment
decoder 250.

In step S10, data converted into the display code
by the segment decoder 240 or 250 is stored in the data
memory 230. In step S11, the display data is output to the
10 LCD driver 210 through the LCD data latch 220 and is
displayed on the LCD 10. In step S12, the message data
processor 6 determines according to status of the input
port 102 whether the display direction change switch S2 has
been operated in the opposite direction. If NO in step
15 S12, the display data latched by the LCD data latch 220 are
sequentially output to the LCD driver 210 and cause the LCD
10 to display the message. The flow then returns to step
S11. Therefore, the display state is kept unchanged.

However, if YES in step S12, the flow returns to
20 step S2. The message data processor 6 transfers again the
message data displayed in step S11 from the RAM 170 to the
display controller 9.

Since the message data processor 6 determines in
step S12 that the change switch S2 has been operated in the
25 opposite direction, in order to display the message whose
display direction is rotated through 180° with respect to
the LCD display information, the command is generated as

follows. If the command generated for the previous LCD display is SD1, the command SD2 is generated. Otherwise, the command SD1 is generated.

Figs. 7A and 7B show a change in display direction when the display direction change switch S2 is operated. Assume that the user carries the pager attached to the waistband and that the display direction change switch S2 is turned off to set the display direction shown in Fig. 7A. When the user wishes to carry the pager in the breast pocket, he or she operates the display direction change switch S2, so that the display direction is changed, as shown in Fig. 7B. The numerals are rotated through 180°, and at the same time, the left-to-right order of numerals is reversed. In this manner, the information can be correctly read regardless of pager attachment positions. As a result, information read errors can be reduced.

The means for designating the display direction may be a manually operated switch mounted on an outer surface of a pager for operation by a user.

CLAIMS

1. A pager including a receiver for receiving a radio frequency signal modulated by at least a radio selective call signal and a display information signal, a memory for storing a display information signal received by the receiver, a display device for displaying information corresponding to the display information signal stored in the memory, the information to be displayed including a plurality of portions which correspond to addresses of the memory in a one to one correspondence, means for inputting a designated display direction of the display information, means for reading the portions to the display device with an addressing order corresponding to the display direction designated by the inputting means, and decoder means for decoding an output from the memory in units of said portions in a decoding manner corresponding to the designated display direction to output the decoded result as display data to the display device, the display displaying the information to be displayed in the designated display direction in accordance with the display data output from the decoder means.
2. A pager as claimed in claim 1 including a manual switch for designating one of first and second display direction modes and constituting the inputting means, the display device displaying the display information in one of the first and second display direction modes as if the information displayed in the other display direction mode



were rotated as a whole by 180 degrees along the display, means for reading the information out of the memory with an incrementing addressing order or a decrementing addressing order in accordance with the designation of the first or second display direction mode, respectively, and segment decoder means for decoding an output of the reading means into units of segments in order to output to the display device first display data corresponding to the first display direction mode and second display data corresponding to the second display direction mode, the display device displaying the segments of the message in the first and second display direction modes by using the first and second display data, respectively.

3. A pager as claimed in Claim 1 substantially as described herein with reference to Figures 2-6 of the accompanying drawings.
