

The invention in question concerns a method for controlling a matrix display according to the preamble of the main claim as well as a device, suitable for executing the method according to the invention, according to the preamble of the first device claim.

It is known, for example from GB-A-2179185, that for picture reproduction to an increasing extent, not only cathode ray tubes but also so-called matrix indicator units, also called matrix displays, are used. These can be constructed as liquid crystal displays (LCDs), plasma displays or similar.

Matrix displays consist of an arrangement of $M * N$ picture elements, so-called pixels. Here, M is the number of these picture elements per line and N is the number of lines.

The control of picture elements is normally carried out line by line, i.e. an analog video signal, containing the information of a picture line, is firstly scanned M times. It is also conceivable that the M scanning values are available already from a previous signal processing.

The scanning values are series-to-parallel converted so that all M scanning values are available at the same time for controlling a display line. The appropriate display line is addressed, whereby the scanning values available in parallel can be written into the appropriate display line.

The clock frequency f_t for controlling signal processing devices, which *inter alia* perform the above-mentioned series-to-parallel conversion and control the matrix display, depends on a number M' of picture elements to be presented per line.

$$f_t = M' / T_z \text{ a}$$

(1)

T_{za} is the duration of the video signal to be presented within one line.

Specification GB-A-2179185 already mentioned presents an interface in which a period for carrying out a signal processing algorithm for the control of a matrix display is extended in time periods in which a video signal being transmitted from a transmitter or a storage means contains no picture information.

For this, the picture data of a video signal being transmitted is written at a first high clock frequency into a store and the picture data for control of the matrix display is read out at a second clock frequency which is smaller than the first. The known interface does not however permit the number of lines to be displayed in relation to the number of lines to be transmitted.

It is the object of the present invention so to reduce the ratio

$$f_t/Z_a \quad (2)$$

where

- f_t is the clock frequency for the signal processing and for controlling the matrix display, and
- Z_a represents the number of lines to be displayed, that Z_a is increased.

This task is solved when using a known-type method by means of the features of the main claim, and by a suitable device for executing the method according to the invention having the features of the first device claim.

The invention is based on the following finding.

For controlling cathode ray tubes, like those used up

to now in conventional picture reproduction devices such as television devices, monitors and similar, after writing each individual picture line the electron beam must be guided back to the start of the next picture line. This feed-back requires a certain length of time. It is for this reason that a horizontal blanking period is provided within each line in which there is no active video signal from which the picture to be presented is derived.

Furthermore, in controlling a cathode ray tube, after writing the final line of each picture the electron beam must be guided back to the start of the first line. The time required for this is designated the vertical blanking period and taken into account in the video signal to be processed by non-visible flyback lines.

In addition, with cathode ray tubes an overwrite in the horizontal and vertical direction is usually performed because of tolerances which result from the manufacturing process, ageing, etc., whereby the picture area to be presented is reduced in both the horizontal and vertical direction.

In contrast to this, when controlling a matrix display consideration of the horizontal and vertical blanking periods is not necessary.

Therefore, these periods are available for the above named signal processing algorithms and the associated clock frequency can be reduced.

This reducing of the clock frequency has the advantages that an increase in the number of controlled lines leads to a reduction in the visible line structure.

When using a matrix display with for example 560 lines and preparing a video signal according to M-norm (US norm)

with approximately 482 active lines, an extension of the picture to be displayed to 560 lines is possible.

By this means there is reduced visibility of the line structure, as well as better use of an eventually available matrix display with a larger number of available lines. When using an optical system designed for the maximum number of lines of the display, there results by control of the entire matrix display an increase of the light output.

Further features, advantages and details of the invention are explained in the following embodiment examples by means of the drawing. It shows in:

- Fig. 1 the progression of a conventional colour video signal,
- Fig. 2 a temporal picture build-up according to the state of the art,
- Fig. 3 a first embodiment example according to the device according to the invention,
- Fig. 4 a second embodiment example according to the device according to the invention,
- Fig. 5 a temporal picture build-up according to the second embodiment example,
- Fig. 6 symbolic memorizing and reading procedures according to the second embodiment example.

Fig. 1 shows, symbolically, the progression of a video picture line 10, known as such, which is composed of an active part 11 and a non-active part 12. The total duration of the line 10 is T_z , of which the active part 11 occupies the duration T_{za} .

Fig. 2 shows the temporal build-up of a video picture or, respectively, field with the use of line interlace signals. This consists of a total number Z of lines, of which Z_a are active, i.e. contain picture information.

Let it be assumed that each of these lines has a progression like that shown symbolically in Fig. 1. The temporal duration of each of the named lines is T_z . If merely such lines are considered as contain picture information, then there is a number Z_a of them and the length of time for the transmission of the active lines is T_{ba} .

In the period of time shown in simply hatched form in Fig. 2, which results from the difference

$$T_z - T_{za}, \quad (3)$$

the feedback of the electron beam to the start of the following line is carried out in picture reproduction devices with electron beam tubes.

In the period of time shown cross-hatched in Fig. 2, which results from the difference

$$T_b - T_{ba}, \quad (4)$$

the feedback of the electron beam to the start of the first line is carried out in picture reproduction devices with electron beam tubes.

The lines indicated in Fig. 2 can also follow a course different from that illustrated in Fig. 1. The essential factor is merely that, besides an active part, a non-active part is provided which, depending on the respective television standard, can contain synchronizing impulses such as "sync", "burst", etc..

A device according to a first example embodiment is shown in Fig. 3. A picture source 13, which processes a signal from a recording means or broadcast from a transmitter and comprises, for example, a receiver, a colour

decoder and an analog-to-digital converter, puts out line-by-line a video signal to the data input of a line memory 14. This comprises a first control input 15 and a second control input 16.

At the first control input 15 a first line control signal S1 is present through which the storing (writing-in) of video line data is controlled. At the second control input 16 is a second line control signal S2 through which the reading-out of video line data is controlled.

The signal read out from the line memory 14 is sent to a signal processing unit 17. The signal processed by the signal processing unit 17 is sent to a line serial-to-parallel converter 18, the output signal of which controls a matrix display 19 line-by-line.

Owing to the fact that, as described above, no time periods for the feedback of a beam need be provided for controlling matrix displays, the time periods shown simply hatched in Fig. 2 can, when controlling a matrix display, be additionally used for executing signal processing algorithms and for controlling the matrix display 19.

By just utilizing the horizontal blanking interval $T_z - T_{za}$, the time additionally available for image processing algorithms, can be extended by a factor

$$k_1 \text{ less than or equal to } 1.23$$

For controlling the matrix display 19, an initialization time T_i per line also has to be taken into account. Thus, there results the available duration T_{za}^* for reading-out, processing and displaying a line of

$$T_{za}^* \leq T_z - T_i.$$

(5)

The number M' of picture elements per line to be presented is in this embodiment example identical with the number M of picture elements per line determined by the geometry of the matrix display.

Consequently, the first line control signal $S1$ has a first clock frequency f_t , the value of which results from

$$f_t = M/Tza. \quad (6)$$

The second line control signal $S2$ has a first reduced clock frequency f_t' , the value of which results from

$$f_t' = M/Tza* \quad (7)$$

or,

$$f_t' = f_t/k1, \quad (8)$$

i.e.

$$Tza* = Tza * k1. \quad (9)$$

Thus, the clock frequency required for stages 17, 18 for controlling the matrix display 19 is less for the same number Za of lines to be displayed.

The device of a second embodiment example is shown in Fig. 4. Means which perform the same function as in the first embodiment example in Fig. 3 are designated with the same identifying numbers as in that figure, and these means will only be explained insofar as is necessary for understanding the matter.

The picture source 13 sends its output signal to an image memory 20 which comprises a first control input 21 and a second control input 22.

At the first control input 21 there a first picture control signal $S1'$ is present which controls the storing (writing-in) of video image data. At the second control input 22 there is a second picture control signal $S2'$ which controls the reading-out of video image data.

Various versions can be realised through the progressions of the control signals $S1'$, $S2'$.

If both the horizontal and the vertical blanking intervals are taken into account, then there results a prolongation of the time available for signal processing of up to 33 per cent, i.e. corresponding to a factor

k_2 less than or equal to 1.33.

To do this the active signal output by the picture source 13 is written into the image memory 20, in a manner controlled by the first picture control signal $S1'$, with the following values:

- the clock frequency f_t , corresponding to

$$f_t = M/T_{za}; \text{ and} \quad (6)$$

- a line frequency f_z , corresponding to

$$f_z = Z/T_b; \quad (10)$$

hereby, the picture duration $T_b = 1/f_B$, and f_B is the picture frequency (normally 50 or 60 Hz).

Reading-out of the picture data now takes place, expanded into the vertical blanking gap and in a manner controlled by the second picture control signal $S2'$.

The time available for presenting Z_a lines is designated T_{ba}' .

$$T_{ba} \leq T_{ba}' - T_b \quad (11)$$

As the time for displaying Z_a lines has been increased, there results from this a reduction in the line frequency.

As the number Z_a of lines with picture information is less than the total number Z of lines transmitted by a video signal (see Fig. 2), there results the prolonged duration $T_{z'}$ for a line to be displayed.

$$T_{z'} = T_{ba}' / Z_a, \quad (9)$$

and therefore, the reduced line frequency $f_{t'}$

$$f_{z'} = 1 / T_{z'}. \quad (12)$$

For controlling the matrix display with one line, there now results the total available line duration $T_{za'}$ of

$$T_{za'} \leq T_{z'} - T_i. \quad (13)$$

The reduced clock frequency $f_{t'}$ suitable for this embodiment example is

$$f_{t'} = M / T_{za'}. \quad (14)$$

It should be noted here that the reduced clock frequency $f_{t'}$ is a whole number multiple of the reduced line frequency $f_{z'}$.

A picture build-up according to the second embodiment example is shown in Fig. 5.

It can be seen that for the picture information which is to be shown, which results from the active parts 11 of each line 10 (see Fig. 1) and the number Z_a of lines with picture information, almost the entire original picture

duration T_b is available.

It should be noted that the time T_b (corresponding to the total framed area of hatched and non-hatched region) is the same in Fig. 2 and Fig. 5.

It can also be seen from Fig. 5 that the time T_b' need not be compulsorily divided up into an even number of lines T_b/T_z' .

With a variation of this embodiment example, merely the vertical blanking interval $Z-Z_a$ (see Fig. 2) is taken into account. Thus, the time T_{z+} available for signal processing algorithms increases with respect to that of prior art systems by a factor

k_3 less than or equal to 1.09.

$$T_{z+} = T_z * k_3 \quad (15)$$

From this there follows the corresponding clock frequency f_{t+}

$$f_{t+} = f_t / k_3. \quad (16)$$

With this variation the first picture control signal $S1'$ is modulated with the clock frequency f_t and the second picture control signal $S2'$ with the reduced clock frequency f_{t+} .

If from now on those picture areas which, with cathode ray tubes, are lost through overwriting of the picture area are ignored, then, for a reduced picture content, an even longer time is available for controlling the matrix display 19, whereby a further reduction of the clock frequency is possible.

Fig. 6 shows, symbolically, storing and reading procedures for the image memory 20 of Fig. 4.

As already mentioned, storing takes place with a higher frequency than reading-out. Picture information is only present within an active picture duration during the total picture duration T_b , and this picture information is stored in this period.

After picture duration in a system with reduction of the clock frequency by the factor $k_2=1.33$ is understood to be the time corresponding to the non-hatched area in Fig. 2.

In contrast, the reading-out takes place during a timespan which essentially, in particular considering the initialization time T_i , can correspond to almost the entire picture duration T_b .

The size required for the image memory depends on the region in which the picture presentation is enlarged in the vertical direction. This is the region

$T_b - T_{ba}$.

Taking as a basis a progressive 625-line system with 575 active lines, this corresponds to a maximum region to be stored of up to about 50 lines.

A further embodiment example provides for the clock frequency f_t not to be reduced to the extent which was described in the preceding embodiment examples. Instead however, the video information stored in the image memory 20 is to be displayed over a larger number of lines, when compared with the number Z_a of lines which contain picture information, corresponding to a vertical upward interpolation of the number of lines Z_a .

Therefore, for example, an active video image containing picture information can be read into and out of the memory 20 using the same clock frequency.

The periods of time for the beam feedback are additionally available for the processing by stages 23, 24 as well as for display via the matrix display 19. These periods of time can now be used to control more lines of the matrix display than is provided by the television standard concerned, leading to a reduction of the visible line structure.

In order to reduce or avoid picture distortions, the picture to be displayed can, for example, have its horizontal dimensions stretched. Sections which, thereby, go beyond the horizontal dimension of the matrix display 19 can be cut off (trimmed).

The following application is also conceivable.

When using a matrix display with, for example, 560 lines, and when processing a video image according to the M standard (US standard) using approx. 482 active lines, it is possible to expand the picture to be displayed to 560 lines.

The result of this is that the line structure is less visible and also that a possible matrix display with a larger number of lines available can be better utilized. When using an optic constructed in view of the maximum number of lines in the display, there results, through the controlling of the entire matrix display, an increase in the light efficiency.

Further versions of the named embodiment examples may comprise at least one of the following variations:

- For indirect control of the matrix display 19 means of

- storage can be provided which store the temporally "stretched picture" and the information read out from these serve for a controlling of the matrix display 19;
- the number M' of picture elements to be presented does not correspond to number M of picture elements per line predetermined by the geometry of the matrix display 19. Instead, storage and/or read out of the video signal in the line or, respectively, image memory can be carried out with a lower resolution. Using the picture information so obtained neighbouring picture elements of the matrix display 19 can be jointly controlled so that this displays a video image with lower resolution over almost its entire area. Furthermore, it is conceivable that the picture information only be fed to part of the matrix display 19 as is the case, for example, with picture-in-picture systems.
 - The vertical resolution can also be similarly reduced; instead of storing a single video image (or, respectively, parts thereof), several video images can be stored which can subsequently be displayed via several matrix displays or be recorded;
 - instead of a direct controlling of the matrix display, an indirect controlling is also possible. Direct controlling in this context is understood to be displaying picture information transmitted by the video signal "on-line". With indirect control a recording of the picture information behind memory 14 or, respectively, 20 and later control of the matrix display 19 is carried out.



Patent Claims

1. Method for controlling a matrix display with a multiplicity of picture elements, in which active parts of a transmitted video signal containing picture information are scanned and stored using a first rate which corresponds to the density of predetermined picture information contained in the active parts and to the duration of the active parts of the transmitted video signal, and is read out at a second rate which results from the density of picture information to be displayed and from the time available for its display, characterised in that the density of picture information to be displayed is determined by the number of picture elements to be controlled, in which the number of controlled lines of the matrix display is greater than the number of lines of the video signal transmitted.
2. Method according to claim 1, characterised in that the transmitted video signal corresponds to the M-norm (US-norm).
3. Method according to claim 1 or 2, characterised in that the number of lines of the matrix display to be controlled is 560.
4. Apparatus for controlling a matrix display (19) in which a store (14,20) is provided, controlled by a first pre-determined control signal (S1) in such a way that active parts of a transmitted video signal from a picture source (13) containing picture information are stored using a first rate which corresponds to the density of predetermined picture information contained in the active parts and to the duration of the active parts of the transmitted video signal, and is read out by means of a second pre-determined control signal (S2) at a second rate which results from the density of picture information to be displayed and from the time available for its display, characterised in that the



density of picture information to be displayed is determined by the number of picture elements to be controlled, and that a signal processing device (17) is provided which processes the picture information to be displayed such that the number of controlled lines of the matrix display is greater than the number of lines of the video signal transmitted.

5. Apparatus according to claim 4, characterised in that the transmitted video signal corresponds to the M-norm (US-norm).

6. Apparatus according to claim 4 or 5, characterised in that the number of lines of the matrix display to be controlled is 560.