

BACKGROUND OF THE INVENTION**1. Field of the Invention**

The present invention relates in general to an optical reader for optically reading an informational image such as an one-dimensional bar codes, a multirow type two-dimensional bar code and a matrix type two-dimensional bar code.

2. Description of the Related Art

A large number of sales stores have so far adopted point of sale systems (generally referred to as "POS systems") and a large number of factories have so far adopted physical distribution management systems. In such POS and physical distribution management systems, stock of products are managed by reading informational images such as bar codes printed on tags attached to products, respectively. The informational images are generally representative of product code names, product prices, manufacture's serial numbers, manufacturers' name and the like. The reading of informational image is made by carrying out a process comprising steps of irradiating the surface of the tag on which the informational image is print, and focusing the reflection from the surface of the tag upon an image formation surface of an image sensor through an optical system to transfer the informational image from the surface of the tag to the image formation surface, i.e., to form the informational image on the image formation surface. The process further comprises steps of converting light and shade of the formed informational image into binary data, and recognizing the informational image from the binary data.

In general, the actually prevalent informational images are not unified in expression type. For example, some informational images are expressed by bar codes, and others are expressed by characters. Making an assumption that there are informational images different in expression type from one another, the informational images are usually further different in overall shape and

size from one another. The informational image expressed by the bar code has a rectangular shape extending laterally, while the informational image expressed by the characters has a rectangular shape considerably shorter in lateral direction than that of the informational image expressed by the bar code. In view of the aforesaid actual condition, there has so far been proposed an optical reader disclosed in Japanese Patent Laid-open Publication No 62-114072. The optical reader taught by the publication uses not a plurality of image sensors but only one image sensor to read the informational images different in expression type from one another. More specifically, the optical reader comprises a counter unit for counting in simultaneous relationship with a scanning operation of the image sensor, a memory IC for storing a plurality mask pattern signals prepared for the informational images, respectively, and represented by binary data. The optical reader further comprises gate means for reading out, from the IC memory IC, one of the mask pattern signals suitable for the informational image scanned by the image sensor in accordance with the result of the counter unit, and making a logical product of the output of the image sensor and the read mask pattern signals. As a result, the gate means produces an image data signal divided into unmasked signal portions necessary for the optical reader to recognize the informational image and masked signal portions unnecessary for the optical reader to do so. In other words, the unmasked signal portions of the image data signal are represented by the combination of the high level "1" and the low level "0", while the masked signal portions of the image data signal are represented by only the low level "0". The image data signal outputted from the gate means is temporarily stored in a data buffer before being transmitted to a processing unit that is designed to perform the process of recognizing the informational image. The data buffer compensates a

difference in rate of flow of the image data signal when the image data signal are transferred from the gate means to the processing unit.

A drawback is, however, encountered in a prior-art optical reader of the above described nature in that a data buffer installed into the optical reader is required to have a storage capacity considerably larger than unmasked portions of the image data signal essential for the optical reader to recognize the informational image. The reason is that the masked signal portions as well as the unmasked signal portions are temporarily stored in the data buffer and, as a consequence, the data buffer needs to have useless storage areas for the masked signal portions unnecessary for the optical reader to recognize the informational image. The foregoing drawback results in the fact that the cost and power consumption of the optical reader are increased.

Another drawback is encountered in the prior-art optical reader of the above described nature in that the processing unit of the optical reader spends a long time in reading out the image data from the data buffer and in processing the read image data for the reason described below. Since data temporarily stored in a conventional data buffer are read out in serial at a constant speed, the processing unit is required to read out the redundant masked signal portions each represented by the low level "0" from the data buffer. The processing unit, therefore, spends a long time in reading out the image data from the data buffer and, as a result, takes a long time to process the image data and to recognize the informational image.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to reduce the storage capacity of storage means such as a buffer initially storing therein the image data representative of the informational image and,

accordingly, reduce the cost and power consumption of the optical reader.

It is another object of the present invention to reduce the time to read out the image data from the storage means and, therefore, reduce the time to process the image data and to recognize the informational image.

It is a further object of the present invention to save a user from judging which type or size of the informational image is read by the optical reader.

It is a still further object of the present invention to simplify the construction of an optical reader capable of reading a variety of informational images.

In accordance with one aspect of the present invention, there is provided an optical reader for optically reading an informational image. The optical reader comprises image sensing means having a plurality of pixel elements as a whole forming an image formation surface. Each of the pixel elements receives light and outputs image data based on intensity of the received light. The image sensing means scans the image formation surface to produce an image data signal based on the image data outputted from the pixel elements. The optical reader further comprises image formation means for forming the informational image on the image formation surface of the image sensing means, image data storing means for receiving the image data signal from the image sensing means and temporarily storing therein the image data included in the image data signal, and information recognition means for receiving the image data from the image data storing means and recognizing the informational image from the image data. The optical reader further comprises designation means for designating part of the pixel elements outputting partial image data essential for the optical reader to recognize the informational image, and control means for controlling the image data storing means to have only the

partial image data stored in the image data storing means. The part of the pixel elements forms at least one partial reading surface area in the image formation surface.

In accordance with another aspect of the present invention, there is provided an optical reader for optically reading informational images different in at least one of type and size from one another. The optical reader comprises image sensing means provide with a plurality of pixel elements as a whole forming an image formation surface. Each of the pixel elements receives light and outputs image data based on intensity of the received light. The image sensing means scans the image formation surface to produce an image data signal based on the image data outputted from the pixel elements. The optical reader further comprises image formation means for forming one of the informational images on the image formation surface of the image sensing means, and a plurality of storage devices provided for the informational images, respectively. All of the storage devices receives the image data signal from the image sensing means and temporarily stores therein the image data included in the image data signal representative of the one of the informational images formed on the image formation surface. The optical reader further comprises designation means for designating a plurality of groups of pixel elements respectively outputting groups of partial image data which are essential for the optical reader to recognize the informational images, respectively. Each of the groups of pixel elements forms at least one partial reading surface area in the image formation surface. The optical reader further comprises control means for controlling the storage devices to have only the groups of partial image data stored in the storage devices, respectively, and data selection means for receiving the groups of partial image data from all of the storage devices and selecting one of the groups of

partial image data which is essential for the optical reader to recognize the one of the informational images formed by the image formation means. The selected group of partial image data is used as data indicative of the one of the informational images formed by the image formation means.

In accordance with a further aspect of the present invention, there is provided an optical reader for optically reading informational images different in at least one of type and size from one another. The optical reader further comprises image sensing means provided with a plurality of pixel elements as a whole forming an image formation surface. Each of the pixel elements receives light and outputs image data based on intensity of the received light. The image sensing means scans the image formation surface to produce an image data signal based on the image data outputted from the pixel elements. The optical reader further comprises image formation means for forming one of the informational images on the image formation surface of the image sensing means, a storage device for receiving the image data signal from the image sensing means and temporarily storing therein the image data included in the image data signal representative of the one of the informational images formed by the image formation means on the image formation surface. The optical reader further comprises judgment means for judging which of informational images is formed by the image formation means on the image formation surface, and designation means for designating, in accordance with the judgment by the judgment means, part of the pixel elements outputting partial image data essential for the optical reader to recognize the one of the informational images. The part of the pixel elements form at least one partial reading surface area in the image formation surface. The optical reader further comprises control means for controlling the storage device to have only the partial image data stored in the

storage device, and information recognition means for receiving the partial image data from the storage device and recognizing the one of the informational images formed by the image formation means on the image formation surface.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Fig. 1 is a block diagram showing a first embodiment of the optical reader according to the present invention;

Fig. 2(a) is a diagram showing an one-dimensional bar code to be read by the optical reader shown in Fig. 1;

Fig. 2(b) is a diagram showing a multirow type two-dimensional bar code to be read by the optical reader shown in Fig. 1;

Fig. 3 is a diagram showing an array of pixel elements collectively forming an image formation surface of a two-dimensional image sensor unit shown in Fig. 1;

Fig. 4(a) is a diagram showing a partial reading surface area in the image formation surface on the assumption that the informational image to be read by the optical reader is the one-dimensional bar code shown in Fig. 2(a);

Fig. 4(b) is a diagram showing other partial reading surface areas in the image formation surface on the assumption that the informational image to be read by the optical reader is the multirow type two-dimensional bar code shown in Fig. 2(b);

Figs. 5(a) is a timing chart showing a binary image data signal outputted from a two-dimensional image sensor

unit shown in Fig. 1;

Fig. 5(b) is a timing chart showing an end column signal outputted from a pre-processing unit shown in Fig. 1;

Fig. 5(c) is a timing chart showing a clock signal outputted from a sensor driving unit shown in Fig. 1;

Fig. 5(d) is a timing chart showing a gate signal produced by a control unit shown in Fig. 1;

Fig. 5(e) is a timing chart showing a gated clock signal outputted from the control unit shown in Fig. 1;

Fig. 5(f) is a timing chart showing a latched binary image data signal outputted from a latch unit shown in Fig. 1;

Fig. 6(a) is a diagram showing a matrix type two-dimensional bar code to be read by the optical reader shown in Fig. 1;

Fig. 6(b) is a diagram showing a partial reading surface area in the image formation surface on the assumption that the informational image to be read by the optical reader is the matrix type two-dimensional bar code shown in Fig. 6(a);

Fig. 7 is a block diagram showing a second embodiment of the optical reader according to the present invention;

Fig. 8 is a block diagram showing a third embodiment of the optical reader according to the present invention;

Fig. 9 is a diagram showing a bar code sheet on which an array of one-dimensional bar codes are printed;

Fig. 10 is a perspective view showing a first example of a scanner body having the two-dimensional image sensor unit and the like installed thereinto;

Fig. 11 is a flowchart showing a control operation of the control unit shown in Fig. 8;

Fig. 12(a) is a perspective view showing a second example of the scanner body;

Fig. 12(b) is a partial cross sectional view

showing the scanner body shown in Fig. 12(a);

Fig. 13 is a perspective view showing a third example of the scanner body;

Fig. 14 is a perspective view showing a fourth example of the scanner body;

Fig. 15 is a perspective view showing a fifth example of the scanner body;

Fig. 16 is a perspective view showing a sixth example of the scanner body; and

Fig. 17 is a perspective view showing a seventh example of the scanner body.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 1 to 6 of the drawings, a first preferred embodiment of the optical reader according to the present invention will be described hereinafter. The optical reader is shown in Fig. 1 in the form of a block diagram and designed to read an informational image 2 printed on a reading object surface 1. The informational image 2 is an one-dimensional bar code shown in Fig. 2(a) or a multirow type two-dimensional bar code shown in Fig. 2(b). As will be understood from Figs. 2(a) and 2(b), the one-dimensional bar code represents certain information by a set of parallel black bars b and white spaces s one-dimensionally arranged, while the two-dimensional bar code represents certain information by a plurality of one-dimensional bar codes stacked up in a perpendicular relationship with the bars b of the one-dimensional bar codes.

The optical reader is shown in Fig. 1 as comprising an illumination source 10, a lens system 11, a two-dimensional image sensor unit 12, a sensor driving unit 13, a pre-processing unit 14, an one-dimensional bar code processing unit 15a, a multirow type two-dimensional bar code processing unit 15b, a control unit 17 and a recognition result judgment unit 22. The illumination source 10 is adapted to illuminate the reading object

surface 1 and comprises a light-emitting diode (generally abbreviated to "LED"), a semiconductor laser or the like. When the reading surface 1 is illuminated by the illumination source 10, rays of light depending upon light and shade of the informational image 2 are irregularly reflected in the reading object surface 1. The reflected rays of light are received by the two-dimensional image sensor unit 12 by way of the lens system 11 which comprises one or more lenses. The two-dimensional image sensor unit 12 includes an image formation surface 12 having the informational image 2 formed thereon. More specifically, the two-dimensional image sensor unit 12 is, for example, a charge coupled device (generally abbreviated to "CCD") and has a matrix array of pixel elements. The pixel elements are denoted by "Pe" in Fig. 3 and methodically arranged within a certain rectangular two-dimensional area defined by two axes R and G perpendicular to each other and, accordingly, arranged in the form of a matrix array with m rows and n columns. For, example, m is 490 and n is 640. Each of the pixel elements Pe has, for example, a square shape of 10 μm by 10 μm and is formed by a photoelectric element such as a phototransistor. The image formation surface 12a of the two-dimensional image sensor unit 12 is formed by the matrix array of pixel elements Pe. When the informational image 2 is formed on the image formation surface 12a, each of the pixel elements receives rays of light and produce image data based on intensity of the received rays of light. Since the image data produced by each of the pixel elements Pe is representative of light and shade of the informational image 2 formed on the image formation surface 12a, the imaged data produced by each of the pixel elements Pe can be called a light and shade signal. The pixel elements Pe located in relatively black areas corresponding to the bars b shown in Fig. 2(a) produce a relatively high level of light and shade signal. In contrast, the pixel

elements P_e located in relatively white areas corresponding to the spaces s shown in Fig. 2(a) produce a relatively low level of light and shade signal. If some pixel elements P_e are located in a border between the relatively black area and the relatively white area, corresponding to the edge of the bar b , those pixel elements P_e produces light and shade signals each held at a medium level which is in proportion to a ratio of the relatively black area to the whole sensitive area of each pixel element P_e .

Returning back to Fig. 1 of the drawings, the two-dimensional image sensor unit 12 is controlled by the sensor driving unit 13 to output an image data signal. Specifically, a clock signal is fed from the sensor driving unit 13 to the two-dimensional image sensor unit 12. In accordance with the clock signal, the two-dimensional image sensor unit 12 causes the pixel elements P_e to output the light and shade signals in order and accordingly produce an image data signal formed by light and shade signals arranged in serial. In other words, the two-dimensional image sensor unit 12 produces the image data signal by scanning the image formation surface 12a in accordance with the clock signal from the sensor driving unit 13. The image data signal is transmitted from the two-dimensional image sensor unit 12 to the pre-processing unit 14. In addition, the sensor driving unit 13 supplies the control unit 17 with an end column signal that is representative of the output timing of part of the pixel elements P_e forming a right or left end column of the matrix array of the pixel elements P_e .

The pre-processing unit 14 is designed to carry out processes of sampling and holding the image data signal, removing noises from the image data signal, and amplifying the image data signal. After the processes, the pre-processing unit 14 further carries out a process of converting the image data signal into a binary data signal which is called hereinlater a binary image data

signal. The binary image data signal is transmitted from the pre-processing unit 14 to both of the one-dimensional bar code processing unit 15a and the multirow type two-dimensional bar code processing unit 15b.

The one-dimensional bar code processing unit 15a is provided for the one-dimensional bar code shown in Fig. 2(a), while the multirow type two-dimensional bar code processing unit 15b is provided for the multirow type two-dimensional bar code shown in Fig. 2(b). The one-dimensional bar code processing unit 15a is shown in Fig. 1 as comprising a latch unit 16a, a data buffer 18a, a central processing unit (hereinafter referred to as "CPU" for brevity) 19a, a read-only memory (hereinafter referred to as "ROM" for brevity) 20a and a random access memory (hereinafter referred to as "RAM" for brevity) 21a. Likewise, the multirow type two-dimensional bar code processing unit 15b is shown in Fig. 1 as comprising a latch unit 16b, a data buffer 18b, a CPU 19b, a ROM 20b and a RAM 21b.

The latch unit 16a is designed to latch the binary image data signal by making a logical product of the binary image data signal from the pre-processing unit 14 and a first gated clock signal from the control unit 17 and, as a result, used to stabilize the binary image data signal. Specifically, the binary image data signal from the pre-processing unit 14 can be hardly held at stable state for a short period. If the binary image data is in the unstable state, the data buffer 18a has a difficulty in storing therein the binary image data signal. As described above, the binary image data signal is required to be held at the stable state for a short time corresponding to a pulse width of a certain clock signal such as the first gated clock signal. Likewise, the latch unit 16b is designed to latch the binary image data signal by making a logical product of the binary image data signal from the pre-processing unit 14 and a second gated clock signal from the control unit 17 and, as a

result, used to stabilize the binary image data signal. The aforesaid first and second gated clock signals will become apparent as the description proceeds.

Since the two-dimensional image sensor unit 12, the sensor driving unit 13, the pre-processing unit 14, the latch units 16a and 16b and the control unit 17 as a whole form a sensor side control system which is controlled in a synchronous relationship with the clock signal produced by the sensor driving unit 13, the control system may be called a synchronous control system. The synchronous control system is in the asynchronous relationship with a first CPU side control system formed by the CPU 19a, the ROM 20a and the RAM 21a electrically connected to one another by way of buses, and a second CPU side control system formed by the CPU 19b, the ROM 20b and the RAM 21b electrically connected to one another by way of buses.

The data buffer 18a is interposed between the sensor side control system and the first CPU side control system for compensating for a difference in rate of flow of the binary image data signal when the binary image data signal are transferred from the latch unit 16a to the CPU 19a. Likewise, the data buffer 18b is interposed between the sensor side control system and the second CPU side control system for compensating for a difference in rate of flow of the binary image data signal when the binary image data signal are transferred from the latch unit 16b to the CPU 19b. Each of the data buffers 18a and 18b is, for example, a first-in first-out memory (hereinafter referred to as "FIFO memory").

The control unit 17 is adapted to output two different control signals consisting of a first gated clock signal which is used to control the latch unit 16a and the data buffer 18a, and a second gated clock signal which is used to control the latch unit 16b and the data buffer 18b. The first gated clock signal is formed by making a logical product of the clock signal from the

sensor driving unit 13 and a first gate signal which is prepared for the one-dimensional bar code shown in Fig. 2(a), while the second gated clock signal is formed by making a logical product of the clock signal from the sensor driving unit 13 and a second gate signal which is prepared for the multirow type two-dimensional bar code shown in Fig. 2(b). The first gate signal is produced for the purpose of designating part of the pixel elements P_e that output first partial image data essential for the optical reader to recognize the one-dimensional bar code shown in Fig. 2(a). On the other hand, the second gate signal is produced for the purpose of designating part of the pixel elements P_e that output second partial image data essential for the optical reader to recognize the multirow type two-dimensional bar code shown in Fig. 2(b). More specifically, the high level data of the first gate signal indicates the aforesaid first partial image data of the binary image data signal, while the high level data of the second gate signal indicates the second partial image data of the binary image data signal. When the informational image 2 to be read by the optical reader is the one-dimensional bar code shown in Fig. 2(a), the output data of part of the pixel elements P_e forming a row of the matrix array of the pixel elements P_e is sufficient for the optical reader to recognize the one-dimensional bar code. Therefore, the first partial image data of the binary image data signal are outputted from the pixel elements located within a first partial reading surface area YE1 in the image formation surface 12a shown in Fig. 4(a). When, on the other hand, the informational image 2 to be read by the optical reader is the multirow type two-dimensional bar code shown in Fig. 2(b), the output data of part the pixel elements P_e forming some rows of the matrix array of the pixel elements P_e is sufficient for the optical reader to recognize the multirow type two-dimensional bar code. Accordingly, the second partial image data of the

binary image data signal are outputted from the pixel elements within a plurality of second partial reading surface areas YE2 shown in Fig. 4(b). Since the multirow type two-dimensional bar code may be considered to be a bunch of a plurality of one-dimensional bar codes, the one-dimensional bar codes are represented by pixel elements within the second partial reading surface area YE2, respectively. It is noted that the first partial reading surface area YE1 and the second partial reading surface areas YE2 have margins for compensating the variation of the relative position of the image formation surface 12a with respect to the reading object surface 1. The reason why each of lengths of the second partial reading surface areas YE2 is shorter than that of the first partial reading surface area YE1 or that of a row of the matrix array of the pixel elements Pe is that the length of the multiage type two-dimensional bar code is smaller than that of the one-dimensional bar code.

The control operation of the control unit 17 upon the multirow type two-dimensional bar code processing unit 15b will be described by way of example hereinafter with reference to Fig 5. When the binary image data signal shown in Fig. 5(a) is fed from the pre-processing unit 14 to both of the latch units 16a and 16b, the end column signal shown in Fig. 5(b) is fed from the sensor driving unit 13 to the control unit 17. At this time, the clock signal shown in Fig. 5(c) is also fed from the sensor driving unit 13 to the control unit 17. The pulses the end column signal are counted by the control unit 17. Based on the count of the pulses of the end column signal, the control unit 17 judges the row number of the pixel element Pe from which the binary image data signal currently fed to the latch units 16a and 16b was outputted. In addition, the pulses of the clock signal shown in Fig. 5(c) are counted by the control unit 17 during each period between two adjacent pulses of the end column signal shown in Fig. 5(b). Based on the count of

the clock signal, the control unit 17 judges the column number of the pixel element P_e from which the binary image data signal currently fed to the latch units 16a and 16b was outputted.

The control unit 17 further judges, on the basis of the foregoing two judgments on the row and column numbers, whether the binary image data signal currently fed to the latch 16b is the second partial image data outputted from the pixel elements P_e within the second partial reading surface areas YE2 shown in Fig. 4(b) or not. Only when the control unit 17 judges that the binary image data signal currently fed to the latch 16b is outputted from the pixel elements P_e within the second partial reading surface areas YE2, the second gate signal is partially held at a high level as shown in Fig. 5(d). The second gated clock signal shown in Fig. 5(e) is produced by the control unit 17 from the second gate signal and the clock signal. The second gated clock signal is fed from the control unit 17 to the latch unit 16b. The latch unit 16b is operated to partially latch the binary image data signal to produce the latched binary image data signal shown in Fig. 5(f), i.e., only the second partial image data of the binary image data signal are latched by the latch unit 16b.

The latched binary image data signal is fed from the latch unit 16b to the data buffer 18b. In the meantime, the gated clock signal shown in Fig. 5(e) is fed as a write enable signal from the control unit 17 to the data buffer 18b. Since the data buffer 16b is operated to write therein the latched binary image data signal depending upon the second gated clock signal, only the second partial image data of the binary image data signal essential for the optical reader to recognize the two-dimensional bar code is temporally stored in the data buffer 18b.

In the present embodiment, the second gated clock signal is fed from the control unit 17 to the latch unit

16b in the foregoing embodiment. If, however, desired, the control unit 17 may feed the clock signal instead of the second gated clock signal to the latch unit 16b. In this case, the whole binary image data signal is latched by the latch unit 16b. The reason why, in the present embodiment, not the clock signal but the second gated clock signal is fed from the control unit 17 to the latch unit 16b is that the stabilization of only the second partial image data of the binary image data signal is sufficient for the data buffer 18b to temporarily store only the second partial image data of the binary image data signal.

Although the latch unit 16a and the data buffer 18a is operated in a similar way, the first gate signal and the first gated clock signal are different from the second gate signal and the second gated clock signal, respectively. Since the high level of the first gate signal corresponds to the first partial image data of the binary image data signal, only the first partial image data of the binary image data signal essential for the optical reader to recognize the one-dimensional bar code are temporally stored in the data buffer 18a. Needless to say, the control unit 17 may feed the clock signal instead of the first gated clock signal to the latch unit 16a.

As described hereinbefore, only the first partial image data of the binary image data signal is temporarily stored in the data buffer 18a, while only the second partial image data of the binary image data signal is temporarily stored in the data buffer 18b. In other word, there is no need for the data buffers 18a and 18b to have large storage capacities by occupied by the whole binary image data signal corresponding to the whole image formation surface 12a of the two-dimensional image sensor unit 12. In the present embodiment, the data buffer 18a may have merely a small storage capacity corresponding to data outputted from only one row of the matrix array of

the pixel elements P_e , while the data buffer 18b may have merely a small storage capacity corresponding to data outputted from only some rows, or only six rows of the matrix array of the pixel elements P_e .

After all of the first partial image data of the binary image data signal is stored in the data buffer 18a, the first partial image data of the binary image data signal is read out by the CPU 19a. One-dimensional bar code recognition program stored in the ROM 20a is executed by the CPU 19a to recognize the one-dimensional bar code. When the one-dimensional bar code recognition program is executed by the CPU 19a, the RAM 21a serves as a work area used by the one-dimensional bar code recognition program for temporary storage of data. Likewise, after all of the second partial image data of the binary image data signal is stored in the data buffer 18b, the second partial image data of the binary image data signal is read out by the CPU 19b. Multirow type two-dimensional bar code recognition programs stored in the ROM 20b are executed by the CPU 19b to recognize the multirow type two-dimensional bar code. When the multirow type two-dimensional bar code programs are executed by the CPU 19b, the RAM 21b serves as a work area used by the multirow type two-dimensional bar code recognition programs for temporary storage of data.

The results of the recognition operations by the CPUs 19a and 19b are supplied to the recognition result judgment unit 22. The recognition result judgment unit 22 is designed to judge which recognition result is successful in recognizing the informational image 2. The result of the judgment by the recognition result judgment unit 22 is send to for example an upper-level computer (not shown) such as a main computer or a host computer. If the informational image 2 is the one-dimensional bar code shown in Fig. 2(a), the recognition result by the CPU 19a is to be successful in recognizing the informational image 2. If the informational image 2 is

the multirow type two-dimensional bar code shown in Fig. 2(b), the recognition result by the CPU 19b is to be successful in recognizing the informational image 2.

As will be appreciated from the foregoing description, the optical reader can succeed for certain in reading the informational image 2 if any of the bar codes shown in Figs. 2(a) and 2(b) is printed on the reading object surface 1 as the informational image. In addition, the storage capacities of the data buffers 18a and 18b can be reduced in comparison with those of the prior-art optical reader required to have a large storage capacity filled with the whole binary image data signal because of the fact that the small storage capacities are sufficient for the data buffer 18a or 18b to temporarily store therein the first and second partial image data of the binary image data signal. This means that reductions of the cost and the power consumption of the optical reader are ensured. Since, furthermore, the data buffers 18a and 18b temporarily store therein not the whole binary image data signals but only the first partial image data and the second partial image data, respectively, the CPUs 19a and 19b can read out the data for a short time from the data buffers 18a and 18b, respectively, thereby making it possible to reduce the time to recognize the informational image 2.

Although the informational image 2 is assume, by way of example, as being either of the one-dimensional bar code or the multirow type two-dimensional bar code, the optical reader according to the present invention can be so modified as to fulfill the requirements for reading a matrix type two-dimensional image bar code shown in Fig. 6(a) and/or characters instead of or in addition to the one-dimensional bar code and the multirow type two-dimensional bar code. In order for the optical reader to fulfill the requirements, the optical reader has a need to include a matrix type two-dimensional image bar code processing unit and/or a character processing unit

similar to and arranged in parallel relationship to the one-dimensional and multirow type two-dimensional bar code processing units 15a and 15b.

If the optical reader is thus modified, the control unit 17 is required to store therein a third gate signal and/or a fourth gate signal. The third gate signal is used to designate third partial image data of the binary image data signal essential for the optical reader to recognize the matrix type two-dimensional bar code. the fourth gate signal is used to designate fourth partial image data of the binary image data signal essential for the optical reader to recognize the characters. The third partial image data of the binary image data signal is outputted from part of the pixel elements within a third partial reading surface area YE3 which is shown in Fig. 6(b) as having a rectangular shape, while the fourth partial image data of the binary image data signal is outputted from all of the pixel elements in a fourth partial reading surface area which is, for example, identical with the whole image formation surface 12a. The reason why the third partial reading surface area YE3 and the fourth partial reading surface area are thus defined is that processing units are to required to recognize the matrix type two-dimensional bar code and the characters through so-called image processing techniques.

Referring to Fig 7 of the drawings, a second embodiment of the optical reader according to the present invention will be described hereinafter. The second embodiment of the optical reader includes the same constitutional elements as the first embodiment of the optical reader does. The constitutional elements of the second embodiment are respectively designated by the same reference numerals and symbols as the individual constitutional elements of the first embodiment are done, with the intention of omitting repeated description thereof. In the first embodiment, a plurality of

recognition operations are made in parallel processing, under the assumption that the currently inputted binary image data signal is suitable for any of the processing units 15a and 15b to recognize the informational image 2, and, finally, one of a plurality of recognition results which is successful in recognizing the informational image 2 is selected and used. In contrast, the second embodiment is characterized in that one recognition operation is sufficient for the optical reader to recognize the informational image 2 if the informational image 2 is made in any expression form.

The optical reader shown in Fig. 7 is designed to be capable of reading first to fourth informational images different in expression type from one another. More specifically, the optical reader is shown in Fig. 7 as including a latch unit 30, a data buffer 31, a CPU 32, a RAM 33 and ROMs 34a, 34b, 34c and 34d, an image type judgment means 35 and a control unit 36 in addition to the illumination source 10, the lens system 11, the two-dimensional image sensor unit 12, the sensor driving unit 13, the pre-processing unit 14. The control unit 36 is able to produce four different control signals consisting of first to fourth gated clock signals each similar to the gated clock signal shown in Fig. 5(e) and supplies one of the first to fourth gated clock signals to the latch unit 30 and the data buffer 31. The first to fourth gated clock signals are used to designate first to fourth groups of pixel elements outputting first to fourth groups of partial image data which are essential for the optical reader to recognize the first to fourth informational images, respectively. The first to fourth groups of pixel elements respectively form one or more first to fourth partial reading surface areas, respectively, in the image formation surface 12a. The data buffer 31 is required to have a storage capacity larger than the volume of image data outputted from the pixel elements within the largest one of the first to

fourth partial reading surface areas. The ROMs 34a, 34b, 34c and 34d store therein first to fourth recognition programs which are executed by the CPU 32 to recognize the first to fourth informational images, respectively.

The image type judgment means 35 is adapted to judge which type of informational image, i.e., which of the first to fourth informational images is formed on the image formation surface 12a by the lens system 11. The result of the judgment made by the image type judgment means 35 is transmitted to the control unit 36. For instance, the image type judgment means 35 is constituted by an input device operated by a user to allow the user's judgment upon the type of the informational image to be inputted thereinto. Alternatively, the image type judgment means 35 may be an internal switch, an upper-level computer (not shown) held in communication with the optical reader, or a storage device such as a ROM storing therein data indicative of the types of the informational images or the like.

When the image type judgment means 35 judges which of the first to fourth informational images is formed on the image formation surface 12a, the result of the judgment by the image type judgment means 35 is transmitted to the CPU 32 by way of the control unit 36. In the following description, it is assumed that the image type judgment means 35 judged that the first informational image is formed on the image formation surface 12a. The CPU 32 reads out from the ROM 34a the first recognition program prepared for the first informational image. When, in the meantime, the two-dimensional image sensor 12 starts to output an image data signal, the first gated clock signal prepared for the first informational image is supplied from the control unit 36 to the latch unit 30 and the data buffer 31. As a consequence, only the first partial image data of the binary image data signal designated in accordance with the first gated clock signal is temporarily stored

in the data buffer 31. When the first partial image data of the binary image data signal is completely stored in the data buffer 31, the currently read first recognition program is executed by the CPU 32 to recognize the first informational image on the basis of the first partial image data of the binary image data signal stored in the data buffer 31.

In the aforementioned description, the first informational image is assumed, by way of example, as being formed on the image formation surface 12a. If any of other informational images, i.e., the second, third or fourth informational image is formed on the image formation surface 12a, the optical reader is operated in a similar manner. If the second informational image is formed on the image formation surface 12a, the image type judgment means 35 informs the control unit 36 and the CPU 32 of so. As a consequence, the second gated clock signal is transmitted from the control unit 36 to the latch unit 30 and the data buffer 31 as well as the second recognition program is read out from the ROM 34b and executed by the CPU 32. If the third informational image is formed on the image formation surface 12a, image type judgment means 35 informs the control unit 36 and the CPU 32 of so. As a consequence, the third gated clock signal is transmitted from the control unit 36 to the latch unit 30 and the data buffer 31 as well as the third recognition program is read out from the ROM 34c and executed by the CPU 32. If the fourth informational image is formed on the image formation surface 12a, the image type judgment means 35 informs the control unit 36 and the CPU 32 of so. As a consequence, the fourth gated clock signal is transmitted from the control unit 36 to the latch unit 30 and the data buffer 31 as well as the fourth recognition program is read out from the ROM 34d and executed by the CPU 32.

As will be appreciated from the foregoing description of the second embodiment, the informational

image can be recognized by only one type of recognition process, i.e., the execution of only one of the first to fourth recognition programs. This means that the recognition action and the construction of the optical reader can be simplified in comparison with the optical reader of the first embodiment required to performed a plurality of recognition processes in parallel. Since the data buffer 31 stores therein only the partial image data of the binary image data signal, the CPU 32 can read out the data for a short time from the data buffer 31, thereby making it possible to reduce the time to recognize the informational image 2.

In the second embodiment, the optical reader is assumed, by way of example, as being able to read the informational images different in expression type from one another. If, however, desired, the optical reader is so designed as to be able to read only the informational images equal in expression type. If the optical reader is thus constructed, there is no need for the optical reader to include the image type judgment means 35 and the ROMs 34b, 34c and 34d. In addition, the storage capacity of the data buffer 31 can be reduced. If the informational images to be read by the optical reader are the one-dimensional bar codes, a small storage capacity corresponding to data outputted from one row of the matrix array of the pixel elements Pe is sufficient for the data buffer 31 to temporally store therein the binary image data signal.

Referring to Figs 8-17 of the drawings, a third embodiment of the optical reader according to the present invention will be described hereinafter. The third embodiment of the optical reader includes the same constitutional elements as the second embodiment of the optical reader does. The constitutional elements of the third embodiment are respectively designated by the same reference numerals and symbols as the individual constitutional elements of the second embodiment are

done, with the intention of omitting repeated description thereof. In the first and second embodiments, the informational images to be read by the optical reader are different in expression type from one another. In contrast, the third embodiment of the optical reader is characterized in that the informational images to be read by the optical reader are equal in expression type to one another and but different in size from one another. For instance, the one-dimensional bar code printed on a bar code label is larger than that printed on a bar code sheet.

The optical reader is shown in Fig. 8 as comprising a ROM 37, a image size judgment means 38 and a control unit 39 in addition to the illumination source 10, the lens system 11, the two-dimensional image sensor unit 12, the sensor driving unit 13, the latch unit 30, the data buffer 31, the CPU 32, the RAM 33.

The control unit 39 is able to produce a plurality of different control signals consisting of gated clock signals each similar to the gated clock signal shown in Fig. 5(e) and supplies one of the gated clock signals to the latch unit 30 and the data buffer 31. The gated clock signals are used to designate a plurality of groups of pixel elements outputting a plurality of groups of partial image data which are essential for the optical reader to recognize the informational images, respectively. Each of the groups of pixel elements forms one or more partial reading surface areas in the image formation surface 12a. The data buffer 31 is required to have a storage capacity larger than the volume of image data outputted from the pixel elements within the largest one of the partial reading surface areas. The ROM 37 stores therein a recognition program which are executed by the CPU 32 to recognize the informational images different in size from one another. Since the informational images to be read by the optical reader are equal in expression type to one another, one recognition

program is sufficient for the optical reader to recognize the informational images.

The image size judgment means 38 is adapted to judge which size of informational image, i.e., which of the informational images is formed on the image formation surface 12a by the lens system 11. The result of the judgment made by the image size judgment means 38 is transmitted to the control unit 39. For instance, the image size judgment means 38 is constituted by an input device operated by a user to allow the user's judgment upon the size of the informational image to be inputted thereinto. Alternatively, the image size judgment means 38 may be an internal switch, an upper-level computer (not shown) held in communication with the optical reader, or a storage device such as a ROM storing therein data indicative of the size of the informational images or the like.

When the image size judgment means 38 judges which of the informational images is formed on the image formation surface 12a, the result of the judgment by the image size judgment means 38 is transmitted to the control unit 39. When the two-dimensional image sensor 12 starts to output an image data signal, one of the gated clock signals is selected by the control unit 39 in accordance with the result of the judgment made by the image size judgment means 38, and supplied from the control unit 39 to the latch unit 30 and the data buffer 31. As a consequence, only one group of partial image data of the binary image data signal designated in accordance with the selected gated clock signal is temporarily stored in the data buffer 31. When the group of partial image data of the binary image data signal is completely stored in the data buffer 31, the recognition program stored in the ROM 37 is executed by the CPU 32 to recognize the informational image on the basis of the group of partial image data of the binary image data signal stored in the data buffer 31.

Fig 9 shows the aforesaid bar code sheet which is A4 size in Japanese Industrial Standard (generally abbreviated to "JIS") and on which a plurality of one-dimensional bar codes arranged in the shape of a matrix array of 4 columns by 10 rows. When one of the one-dimensional bar codes printed on the bar code sheet is formed on the image formation surface 12a of the two-dimensional image sensor 12, other one-dimensional bar codes adjacent to the target one-dimensional bar code is liable to be formed on the image formation surface 12a at the same time. The reason for this is that the one-dimensional bar codes printed on the bar code sheet are close to one another and each has a small size. If other one-dimensional bar codes besides the target one-dimensional bar code are formed on an image formation surface of a prior-art optical reader, the probability is that the prior-art optical reader cannot precisely recognize the target one-dimensional bar code. The drawback encountered in the prior-art optical reader can be eliminated by the optical reader of the third embodiment. The reason why the optical reader of the third embodiment is effective in reading one of the one-dimensional bar codes which are small sized and close to one another is that only the partial image data representative of the target one-dimensional bar code is stored in the data buffer 31 and processed by the CPU 32.

If the image size judgment means 38 is constituted by an input device operated by a user to allow the user's judgment to be inputted to the control unit 39, the input device may be a switch key 41 attached to a scanner body 40 shown in Fig. 10. The scanner body 40 has the illumination source 10, the lens system 11, the two-dimensional image sensor unit 12 and the like installed therein. Since the switch key 41 is attached to a grip portion of the scanner body 40, the user can push the switch key 41 with ease by holding the scanner body 40. The switch key 41 is held at a "ON" state while the user

pushes the switch 41. When the user releases his or her push on the switch key 41, the switch is automatically returned to "OFF" state. Making the assumption that the informational images to be read by the optical reader consist of a small-sized one-dimensional bar code printed on the bar code sheet and a large-sized one-dimensional bar code printed on the bar code label, the description proceeds hereinafter.

While the switch key 41 is held at the "OFF" state, the control unit 39 judges that the large-sized one-dimensional bar code is formed on the image formation surface 12a of the two-dimensional image sensor unit 12 and outputs one of the gated clock signals prepared for the large-sized one-dimensional bar code. While, on the other hand, the switch key 41 is held at the "ON" state, the control unit 39 judges that the small-sized one-dimensional bar code is formed on the image formation surface 12a of the two-dimensional image sensor unit 12 and outputs another one of the gated clock signals prepared for the small-sized one-dimensional bar code. In the optical reader thus constructed, the user can change one of the two image sizes to the other of them with ease and quickness. The construction of the optical reader is, therefore, effective in enhancing the performance of the user interface.

Although, in the foregoing example, the control unit 39 is assumed as judging that the small-sized one-dimensional bar code is formed on the image formation surface 12a only while the user pushes the switch key 41, the control unit 39 may judge, for a certain time, that the small-sized one-dimensional bar code is formed on the image formation surface 12a after the user pushes the switch 41. In the control unit 39 thus constructed, the control unit 39 may automatically cancel the judgment made by the user's operation on the switch key 41 and judges that the large-sized one-dimensional bar code is formed on the image formation surface 12a when

predetermined requirements are fulfilled. One of the predetermined requirements may be the completion of the recognition process. When the recognition process is completed, the CPU 32 provides the control unit 39 with a recognition end signal indicating that the recognition process is completed. Another one of the predetermined requirements may be the expiration of the elapsed time from the start of the user's operation on the switch key 41.

The detailed control process of the control unit 39 depending upon the recognition end signal will be described hereinafter with reference to a flowchart shown in Fig. 11. It is noted that the optical reader assumes an initial state in which the informational image 2 is regarded as the large-sized one-dimensional bar code.

In a step S1, a judgment is made upon whether a switch signal from the switch key 41 is received by the control unit 39 or not. The switch signal is outputted from the switch key 41 when the user operates the switch key 41. If the answer in the step S1 is in the negative "NO", the step S1 is repeated until the answer in the step S1 is in the affirmative "YES". When the answer in the step S1 is in the affirmative "YES", the step S1 proceeds to a step S2 in which a timer included in the control unit 39 starts to measure an elapsed time in response to the switch signal. In a step S3, a judgment is made upon whether the measured elapsed time exceeds a predetermined time or not, i.e., whether the time is up or not. If the answer in the step S3 is in the negative "No", the step S3 is followed by a step S4 in which a judgment is made upon whether the recognition end signal from the CPU 32 is received by the control unit 39 or not. If the answer in the step S4 is in the negative "NO", the step S4 returns to the step S3. When the answers in the steps S3 and S4 are in the affirmative "YES", the steps S3 and S4 proceed to a step S5 in which the optical reader is returned to the initial state.

As will be appreciated from the control operation

shown in Fig. 11, when the recognition process performed by the CPU 32 is not completed without error before the elapsed time exceeds the predetermined time, as well as when the recognition process performed by the CPU 32 is completed without error, the optical reader is automatically returned to the initial state. There is, therefore, no need for the user to operate the switch key 41 for the purpose of returning the optical reader to the initial state and, for this reason, the user's work can be saved.

In the third embodiment, the optical reader may be preferably constructed so as to inform the user of first and second feasible recognition areas (not shown) which are defined in the reading object surface 1 as follows. It is assumed that the partial reading surface areas for the large-sized and small-sized one-dimensional bar codes is called first and second partial reading surface areas. The first and second partial reading surface areas in the image formation surface 12a correspond to the first and second feasible recognition areas, respectively, in the reading object surface 1 when the scanner body 40 is moved to approach the reading object surface 1. When the informational image to be read by the optical reader is the large-sized one-dimensional bar code, the optical reader may inform the user of the first feasible recognition area in the reading object surface 1. When the informational image to be read by the optical reader is the small-sized one-dimensional bar code, the optical reader may inform the user of the second feasible recognition area in the reading object surface 1. The scanner body 40 is shown in Fig. 12(a) as being formed with an opening portion 42 and brought to a standstill with respect to the image formation surface 12a. The scanner body 40 accommodates a guide illumination source 44 which illuminates the reading object surface 1 with visible radiation and which comprises an array of LEDs 43 arranged in a longitudinal direction of the opening

portion 42. When the switch key 41 is operated by the user, only part of the LEDs 43 covering the small-sized one-dimensional bar code are turned on to illuminate the second feasible recognition area in the reading object surface 1. When the optical reader is in the initial state, all of the LEDs 43 covering the large-sized one-dimensional bar code are turned on to illuminate the first feasible recognition area in the reading object surface 1. In the optical reader thus constructed, the user can visually perceive the appropriate feasible recognition area in the reading object surface 1, and, accordingly, the optical reader can read only the desired informational image with accuracy. Alternatively, the user visually perceive the appropriate feasible recognition area or the appropriate partial reading surface area not by seeing the illuminated area but by seeing directly the LEDs 43 through, for example, an opening formed with the scanner body 40. As shown in Fig. 12(b), the LEDs 43 of the guide illumination source 44 may serve as the illumination source 10, thereby making it possible to simplify the construction of the optical reader and reduce the cost of the optical reader.

The optical reader may comprise guide illumination sources 50a and 50b spotlighting the reading object surface 1 with visible radiation as shown in Fig. 13. Each of the guide illumination sources 50a and 50b comprises a plurality of LEDs, semiconductor lasers or the like. Inside four points spotlighted by the guide illumination source 50b define the second feasible recognition area b5 shown in Fig. 13, while outside four points spotlighted by the guide illumination sources 50a and 50b define the first feasible recognition area a5. Therefore, only the guide illumination source 50a is turned on for the purpose of informing the user of the first feasible recognition area a5 in the reading object surface 1, while only the guide illumination source 50b is turned on for the purpose of informing the user of the

second feasible recognition area b5. In the optical reader thus constructed, the user can visually perceive the appropriate feasible recognition area in the reading object surface 1 and, accordingly, the optical reader can read only the desired informational image with accuracy.

In the third embodiment, the optical reader may comprises a combination of a guide illumination source 60a and a cylindrical lens 61a and another combination of a guide illumination source 60b and a cylindrical lens 61b as shown in Fig. 14. The guide illumination sources 60a and 60b are selectively turned on by the control unit 39. When the guide illumination source 60a is turned on, the cylindrical lens 61a causes the illumination source 60a to illuminate only the first feasible recognition surface area a6. When the guide illumination source 60b is turned on, the cylindrical lens 61b causes the illumination source 60b to illuminate only the second feasible recognition area b5. The optical reader shown in Fig. 14 has the same advantage as that shown in Figs. 12(a) and 12(b) does.

In the third embodiment, the optical reader may comprises a combination of a guide illumination source 71a and a lens 72a and another combination of a guide illumination source 71b and a lens 72b as shown in Fig. 15. The guide illumination sources 71a and 71b are selectively turned on by the control unit 39. The scanner body 40 is formed with a pair of recesses 70 which allow, in cooperation with the lens 72a, the illumination source 71a to illuminate the first feasible recognition area a7. The illumination source 71b illuminates, in cooperation with the lens 72b, the second feasible recognition area b7. The optical reader shown in Fig. 15 has the same advantage as that shown in Figs. 12(a) and 12(b) does.

The optical reader comprising some one of the aforesaid modifications shown in Figs. 12-15 is assumed as informing the user of the feasible recognition area by

the visible light. If, however, desired, the optical reader is so constructed as to inform the user of the feasible recognition area by the shape of the opening portion 42 of the scanner body 40. For example, the scanner body 40 may be formed with a concave portion 80 partly defining or adjacent to the opening portion 42 as shown in Fig. 16. The length of the concave portion 80 may be set approximately to that of the small-sized one-dimensional bar code, while the length of the opening portion 42 may be set approximately to that of the large-sized one-dimensional bar code. When the small-sized one-dimensional bar code is read, the user may move the scanner body 40 to adjust the both ends of concave portion 80 to the both ends of the small-sized one-dimensional bar code. When the large-sized one-dimensional bar code is read, the user may move the scanner body 40 to adjust the both ends of the opening portion 42 to the both end of the large-sized one-dimensional bar code. By the user's operation on the scanner body 40, the optical reader can read the informational image with accuracy.

Alternatively, the scanner body 40 may be formed with a pair of convex portions 90 partly defining or adjacent to the opening portion 42 as shown in Fig. 17. The distance between the convex portions 90 is set approximately to the length of the large-sized one-dimensional bar code, while the length of the opening portion 42 with that of the small-sized one-dimensional bar code. The scanner body 40 shown in Fig. 17 is operated by the user in a similar manner, thereby causing the optical reader to read the informational image with accuracy.

Although the control unit 39 shown in Fig. 8 is assumed, by way of example, as designating one from among the two groups of pixel elements, the number of the groups of pixel elements may be set to three or more. If the number is thus set, the optical reader may have at

least two switches 41, at least two concave portions 80, and at least two pair of convex portions 90.

In the first to third embodiments, although the informational image is assumed, by way of example, as being some one of the one-dimensional bar code, the multirow type two-dimensional bar code and the matrix type two-dimensional bar code, the informational images to be read by the optical reader may be classified into more precise categories. Specifically, the one-dimensional bar codes are classified into NW7, JAN, EAN, UPC, ITF, Code39, Code93 and Code128 types. The NW7 type of one-dimensional bar code is shown in Fig. 2(a). The multirow type two-dimensional bar codes are classified into Code49, Code16k and PDF417 types. The code49 of the multirow type two-dimensional bar code is shown in Fig. 2(b). The matrix type two-dimensional bar codes are classified into Data Code, Veri Code, Maxi Code, CP Code, QR Code, Calra Code and Array Tag types. The Data Code of matrix type two-dimensional bar code is shown in Fig. 6(a). For example, the one-dimensional bar code processing unit 15a shown in Fig. 1 may comprise a plurality of processing units for processing the NW7, JAN, EAN, UPC, ITF, Code39, Code93 and Code128, respectively. Likewise, the multirow type two-dimensional bar code processing unit 15b shown in Fig. 1 may comprise a plurality of processing units for processing the Code49, Code16k and PDF417, respectively. The matrix type two-dimensional bar code processing means may comprise a plurality of processing units for processing the Data Code, Veri Code, Maxi Code, CP Code, QR Code, Calra Code and Array Tag types, respectively. If the optical reader of the first embodiment is thus constructed, the recognition processes for the precisely classified bar codes are performed in parallel, thereby making it possible to remarkably reduce the time for the optical reader to recognize the bar codes.

The two-dimensional image sensor unit 12 in each of

the first through third embodiments is used, by way of example, as an image sensor for inputting image information. If, however, the informational images to be read by the optical reader are only of one-dimensional image types such as one-dimensional bar codes, an one-dimensional image sensor may be used as the image sensor.

The many features and advantages of the invention are apparent from the detailed specification and thus it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope thereof. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

WHAT IS CLAIMED IS:

1. An optical reader for optically reading an informational image, comprising:

image sensing means having a plurality of pixel elements as a whole forming an image formation surface, each of said pixel elements receiving light and outputting image data based on intensity of the received light, said image sensing means scanning said image formation surface to produce an image data signal based on the image data outputted from said pixel elements;

image formation means for forming said informational image on said image formation surface of said image sensing means;

image data storing means for receiving said image data signal from said image sensing means and temporarily storing therein the image data included in said image data signal;

information recognition means for receiving the image data from said image data storing means and recognizing said informational image from the image data;

designation means for designating part of said pixel elements outputting partial image data essential for said optical reader to recognize the informational image, the part of said pixel elements forming at least one partial reading surface area in said image formation surface; and

control means for controlling said image data storing means to have only the partial image data stored in said image data storing means.

2. An optical reader as set forth in claim 1, in which said image data storing means comprises a buffer for compensating for a difference in rate of flow of said image data when said image data are transferred from said image sensing means to said information recognition means.

3. An optical reader as set forth in claim 1, in which said informational image is printed on a reading object surface, said optical reader further comprising informing means for informing a user of a feasible recognition area in said reading object surface corresponding to said partial reading surface area in said image formation surface when said informational image printed on said reading object surface is formed on said image formation surface of said image sensing means.

4. An optical reader as set forth in claim 3, said informing means comprises an illumination source for illuminating said reading object surface with visible radiation, and radiation control means for controlling the visual radiation of said illumination source to visualize said feasible recognition area in said reading object surface.

5. An optical reader as set forth in claim 1, in which said informational image is printed on a reading object surface, said image sensing means comprising a scanner body brought to a standstill with respect to said image formation surface, said scanner body being formed with an opening portion which is moved by a user to approach said informational image printed on said reading object surface, said opening portion of said scanner body having at least one of concave and convex portions that serves as a mark informing said user of a feasible recognition area in said reading object surface corresponding to said partial reading surface area in said image formation surface when said informational image printed on said reading object surface is formed on said image formation surface of said image sensing means.

6. An optical reader for optically reading informational images different in at least one of type and size from one another, comprising:

image sensing means provide with a plurality of pixel elements as a whole forming an image formation surface, each of said pixel elements receiving light and outputting image data based on intensity of the received light, said image sensing means scanning said image formation surface to produce an image data signal based on the image data outputted from said pixel elements;

image formation means for forming one of said informational images on said image formation surface of said image sensing means;

a plurality of storage devices provided for said informational images, respectively, all of said storage devices receiving said image data signal from said image sensing means and temporarily storing therein the image data included in said image data signal representative of said one of said informational images formed on said image formation surface;

designation means for designating a plurality of groups of pixel elements respectively outputting groups of partial image data which are essential for said optical reader to recognize said informational images, respectively, and each of said groups of pixel elements forming at least one partial reading surface area in said image formation surface;

control means for controlling said storage devices to have only the groups of partial image data stored in said storage devices, respectively; and

data selection means for receiving said groups of partial image data from all of said storage devices and selecting one of said groups of partial image data which is essential for said optical reader to recognize said one of said informational images formed by said image formation means, the selected group of partial image data being used as data indicative of said one of said informational images formed by said image formation means.

7. An optical reader as set forth in claim 6, in which each of said storage devices comprises a buffer for compensating for a difference in rate of flow of said image data when said image data are transferred from said image sensing means to said data selection means.

8 An optical reader as set forth in claim 6, in which said data selection means comprises a plurality of recognition process units provided for said informational images, respectively, and attempting to recognize, on the basis of said groups of partial image data respectively stored in said storage devices, said one of said informational images formed by said image formation means on said image formation surface,

the selected group of partial image data being one of said groups on the basis of which one of said recognition process units successfully recognized said one of said informational images formed on said image formation surface.

9. An optical reader for optically reading informational images different in at least one of type and size from one another, comprising:

image sensing means provided with a plurality of pixel elements as a whole forming an image formation surface, each of said pixel elements receiving light and outputting image data based on intensity of the received light, said image sensing means scanning said image formation surface to produce an image data signal based on the image data outputted from said pixel elements;

image formation means for forming one of said informational images on said image formation surface of said image sensing means;

a storage device for receiving said image data signal from said image sensing means and temporarily storing therein the image data included in said image data signal representative of said one of said

informational images formed by said image formation means on said image formation surface;

judgment means for judging which of informational images is formed by said image formation means on said image formation surface;

designation means for designating, in accordance with the judgment by said judgment means, part of said pixel elements outputting partial image data essential for said optical reader to recognize said one of said informational images, the part of said pixel elements forming at least one partial reading surface area in said image formation surface;

control means for controlling said storage device to have only the partial image data stored in said storage device; and

information recognition means for receiving the partial image data from said storage device and recognizing said one of said informational images formed by said image formation means on said image formation surface.

10. An optical reader as set forth in claim 9, in which said storage device comprises a buffer for compensating for a difference in rate of flow of said image data when said image data are transferred from said image sensing means to said information recognition means.

11. An optical reader as set forth in claim 9, in which said judgment means comprises an input device operated by a user to allow said user to judge which of informational images is formed on said image formation surface of said image sensing means.

12. An optical reader as set forth in claim 11, in which said input device comprises a switch key provided for predetermined one of said informational images, said judgment means continuing to judge that said

predetermined one of said informational images is formed on said image formation surface of said image-sensing means while said user is operating said switch key.

13. An optical reader as set forth in claim 11, in which said input device comprises a switch key provided for predetermined one of said informational images, said judgment means continuing to judge that said predetermined one of said informational images is formed on said image formation surface of said image sensing means when once said switch key is operated by said user.

14 An optical reader as set forth in claim 13, in which said judgment means judges that one of said informational images different from said predetermined one of said informational images is formed on said image formation surface of said image sensing means before said switch key is operated by said user,

said judgment means making the previously judgment again when said information recognition means completes recognizing said predetermined one of said informational images.

15. An optical reader as set forth in claim 13, in which said judgment means judges that one of said informational images different from said predetermined one of said informational images is formed on said image formation surface of said image sensing means before said switch key is operated by said user,

said judgment means making the previously judgment again when a predetermined time passed since said user started to operate said switch key.

16 An optical reader as set forth in claim 13, in which said judgment means judges that one of said informational images different from said predetermined one of said informational images is formed on said image

formation surface of said image sensing means before said switch key is operated by said user,

said judgment means making the previously judgment again when said switch key is operated again by said user.

17. An optical reader as set forth in claim 9, in which each of said informational images is printed on a reading object surface, said optical reader further comprising informing means for informing said user of a feasible recognition area in said reading object surface corresponding to the partial reading area surface in said image formation surface when each of said informational images printed on said reading object surface is read by said optical reader.

18. An optical reader as set forth in claim 17, said informing means comprises a guide illumination source for illuminating said reading object surface with visible radiation, and radiation control means for controlling the visual radiation of said guide illumination source to visualize said feasible recognition area in said reading object surface.

19. An optical reader as set forth in claim 9, in which each of said informational images is printed on a reading object surface, said image sensing means comprising a scanner body brought to a standstill with respect to said image formation surface, said scanner body being formed with an opening portion which is moved by said user to approach the informational image printed on said reading object surface, and said opening portion of said scanner body having at least one of concave and convex portions that serves as a mark informing said user of a feasible recognition area in said reading object surface corresponding to the partial reading surface area in said image formation surface when said one of said

- 43 -

informational images printed on said reading object surface is read by said optical reader.



CLAIMS FOR REFERENCE

1. An optical reader for optically reading an informational image (2), comprising:

image sensing means (12) having a plurality of pixel elements as a whole forming an image formation surface (12a), each of said pixel elements receiving light and outputting image data based on intensity of the received light, said image sensing means (12) scanning said image formation surface to produce an image data signal based on the image data outputted from said pixel elements;

image formation means (10, 11) for forming said informational image (2) on said image formation surface (12a) of said image sensing means (12);

image data storing means (18a, 18b; 31) for receiving said image data signal from said image sensing means (12) and temporarily storing therein the image data included in said image data signal;

information recognition means (19a, 20a, 21a; 19b, 20b, 21b; 32, 33, 34; 32, 33, 37) for receiving the image data from said image data storing means (18a, 18b; 31) and recognizing said informational image (2) from the image data;

designation means (17; 35; 38) for designating part of said pixel elements outputting partial image data essential for said optical reader to recognize the informational image (1), the part of said pixel elements forming at least one partial reading surface area (YE1, YE2, YE3) in said image formation surface (12); and

control means (17; 36; 39) for controlling said image data storing means to have only the partial image data stored in said image data storing means.

2. An optical reader as set forth in claim 1, in which said image data storing means (18a, 18b; 31) comprises a buffer for compensating for a difference in rate of flow of said image data when said image data are transferred



from said image sensing means (12) to said information recognition means (19a, 20a and 21a; 19b, 20b and 21b; 32, 33 and 34; and 32, 33 and 37).

3. An optical reader as set forth in claim 1, in which said informational image is printed on a reading object surface (1), said optical reader further comprising informing means (44; 50a, 50b; 60a, 60b; 71a, 71b) for informing a user of a feasible recognition area (a5, b5; a6, b6; a7, b7) in said reading object surface (1) corresponding to said partial reading surface area in said image formation surface (12a) when said informational image (2) printed on said reading object surface (1) is formed on said image formation surface (12a) of said image sensing means (12).

4. An optical reader as set forth in claim 3, said informing means (44; 50a, 50b; 60a, 60b; 71a, 71b) comprises an illumination source for illuminating said reading object surface (1) with visible radiation, and radiation control means (36; 39) for controlling the visual radiation of said illumination source to visualize said feasible recognition area (a5, b5; a6, b6; a7, b7) in said reading object surface (1).

5. An optical reader as set forth in claim 1, in which said informational image (2) is printed on a reading object surface (1), said image sensing means (12) comprising a scanner body (40) brought to a standstill with respect to said image formation surface (12a), said scanner body (40) being formed with an opening portion (42) which is moved by a user to approach said informational image (2) printed on said reading object surface (1), said opening portion (42) of said scanner body (40) having at least one of concave and convex portions (80; 90) that serves as a mark informing said user of a feasible recognition area in said reading



object surface (1) corresponding to said partial reading surface area in said image formation surface (12a) when said informational image printed on said reading object surface (1) is formed on said image formation surface (12a) of said image sensing means (12).

6. An optical reader for optically reading informational images (2) different in at least one of type and size from one another, comprising:

image sensing means (12) provide with a plurality of pixel elements as a whole forming an image formation surface (12a), each of said pixel elements receiving light and outputting image data based on intensity of the received light, said image sensing means (12) scanning said image formation surface (12a) to produce an image data signal based on the image data outputted from said pixel elements;

image formation means (10, 11) for forming one of said informational images (2) on said image formation surface (12a) of said image sensing means (12);

a plurality of storage devices (18a, 18b) provided for said informational images (2), respectively, all of said storage devices (18a, 18b) receiving said image data signal from said image sensing means (12) and temporarily storing therein the image data included in said image data signal representative of said one of said informational images (2) formed on said image formation surface (12a);

designation means (17) for designating a plurality of groups of pixel elements respectively outputting groups of partial image data which are essential for said optical reader to recognize said informational images (2), respectively, and each of said groups of pixel elements forming at least one partial reading surface area (YE1, YE2) in said image formation surface (12a);

control means (17) for controlling said storage devices to have only the groups of partial image data



stored in said storage devices (18a, 18b), respectively; and

data selection means (19a, 20a, 21a, 19b, 20b, 21b, 22) for receiving said groups of partial image data from all of said storage devices (18a, 18b) and selecting one of said groups of partial image data which is essential for said optical reader to recognize said one of said informational images (2) formed by said image formation means (10, 11), the selected group of partial image data being used as data indicative of said one of said informational images (2) formed by said image formation means (10, 11).

7. An optical reader as set forth in claim 6, in which each of said storage devices (18a, 18b) comprises a buffer for compensating for a difference in rate of flow of said image data when said image data are transferred from said image sensing means to said data selection means.

8 An optical reader as set forth in claim 6, in which said data selection means comprises a plurality of recognition process units (19a, 20a, 21a; 19b, 20b, 21b) provided for said informational images (2), respectively, and attempting to recognize, on the basis of said groups of partial image data respectively stored in said storage devices (18a, 18b), said one of said informational images (2) formed by said image formation means (10, 11) on said image formation surface (12a),

the selected group of partial image data being one of said groups on the basis of which one of said recognition process units (19a, 20a, 21a; 19b, 20b, 21b) successfully recognized said one of said informational images (2) formed on said image formation surface (12a).

9. An optical reader for optically reading informational images (2) different in at least one of



type and size from one another, comprising:

image sensing means (12) provided with a plurality of pixel elements as a whole forming an image formation surface (12a), each of said pixel elements receiving light and outputting image data based on intensity of the received light, said image sensing means (12) scanning said image formation surface (12a) to produce an image data signal based on the image data outputted from said pixel elements;

image formation means (10, 11) for forming one of said informational images on said image formation surface (12a) of said image sensing means (12);

a storage device (31) for receiving said image data signal from said image sensing means (12) and temporarily storing therein the image data included in said image data signal representative of said one of said informational images (2) formed by said image formation means (10, 11) on said image formation surface (12a);

judgment means (35; 38) for judging which of informational images (2) is formed by said image formation means (10, 11) on said image formation surface (12a);

designation means (36; 39) for designating, in accordance with the judgment by said judgment means (35; 38), part of said pixel elements outputting partial image data essential for said optical reader to recognize said one of said informational images (2), the part of said pixel elements forming at least one partial reading surface area in said image formation surface (12a);

control means for controlling said storage device (31) to have only the partial image data stored in said storage device (31); and

information recognition means (32, 33, 34; 32, 33, 37) for receiving the partial image data from said storage device (31) and recognizing said one of said informational images (2) formed by said image formation means (10, 11) on said image formation surface (12a).



10.- An optical reader as set forth in claim 9, in which said storage device (31) comprises a buffer for compensating for a difference in rate of flow of said image data when said image data are transferred from said image sensing means to said information recognition means.

11. An optical reader as set forth in claim 9, in which said judgment means (35; 38) comprises an input device operated by a user to allow said user to judge which of informational images is formed on said image formation surface (12a) of said image sensing means (12).

12. An optical reader as set forth in claim 11, in which said input device comprises a switch key (41) provided for predetermined one of said informational images (2), said judgment means (35; 38) continuing to judge that said predetermined one of said informational images (2) is formed on said image formation surface (12a) of said image sensing means (12) while said user is operating said switch key (41).

13. An optical reader as set forth in claim 11, in which said input device comprises a switch key (41) provided for predetermined one of said informational images (2), said judgment means (35; 38) continuing to judge that said predetermined one of said informational images (2) is formed on said image formation surface (12a) of said image sensing means (12) when once said switch key (41) is operated by said user.

14. An optical reader as set forth in claim 13, in which said judgment means (35; 38) judges that one of said informational images (2) different from said predetermined one of said informational images (2) is formed on said image formation surface (12a) of said



image sensing means (12) before said switch key (41) is operated by said user,

said judgment means (35; 38) making the previously judgment again when said information recognition means (32, 33, 34; 32, 33, 37) completes recognizing said predetermined one of said informational images (2).

15. An optical reader as set forth in claim 13, in which said judgment means (35, 38) judges that one of said informational images (2) different from said predetermined one of said informational images (2) is formed on said image formation surface (12a) of said image sensing means (12) before said switch key (41) is operated by said user,

said judgment means (35, 38) making the previously judgment again when a predetermined time passed since said user started to operate said switch key (41).

16 An optical reader as set forth in claim 13, in which said judgment means (35, 38) judges that one of said informational images (2) different from said predetermined one of said informational images (2) is formed on said image formation surface (12a) of said image sensing means (12) before said switch key (41) is operated by said user,

said judgment means (35, 38) making the previously judgment again when said switch key (41) is operated again by said user.

17. An optical reader as set forth in claim 9, in which each of said informational images (2) is printed on a reading object surface (1), said optical reader further comprising informing means (44; 50a, 50b; 60a, 60b; 71a, 71b) for informing said user of a feasible recognition area (a5, b5; a6, b6; a7, b7) in said reading object surface (1) corresponding to the partial reading area surface in said image formation surface (12a) when each



- 51 -

of said informational images (2) printed on said reading object surface (1) is read by said optical reader.

18. An optical reader as set forth in claim 17, said
5 informing means comprises a guide illumination source for illuminating said reading object surface with visible radiation, and radiation control means (36; 39) for controlling the visual radiation of said guide illumination source to visualize said feasible
10 recognition area (a5, b5; a6, b6; a7, b7) in said reading object surface 1.

19. An optical reader as set forth in claim 9, in which each of said informational images (2) is printed on a
15 reading object surface (1), said image sensing means (12) comprising a scanner body (40) brought to a standstill with respect to said image formation surface (12a), said scanner body (40) being formed with an opening portion (42) which is moved by said user to approach the
20 informational image (2) printed on said reading object surface (1), and said opening portion (42) of said scanner body (40) having at least one of concave and convex portions (80; 90) that serves as a mark informing
25 said user of a feasible recognition area in said reading object surface (1) corresponding to the partial reading surface area in said image formation surface (12a) when said one of said informational images (2) printed on said reading object surface (1) is read by said optical reader.