(54) Title: LCD BARCODE SCANNER WITH CAPABILITY OF SCANNING LCD BARCODE
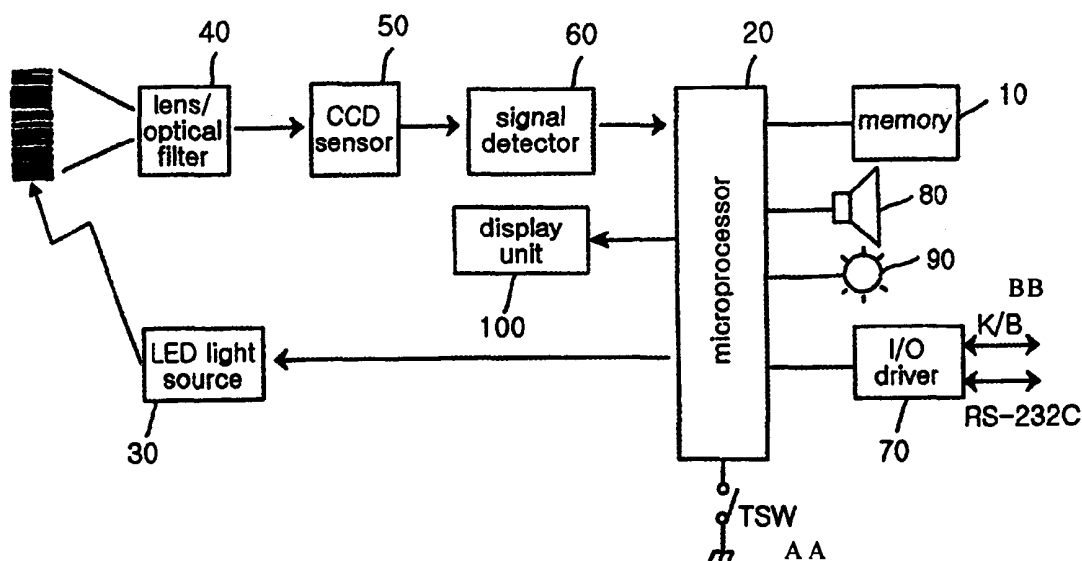
(57) Abstract: A scanner for recognizing barcodes displayed on liquid crystal displays of mobile terminals such as a cellular phone, PDA and pager. The liquid crystal display barcode scanner is capable of scanning and decoding customer information displayed on the liquid crystal displays of the mobile terminals in the form of barcodes, thereby identifying customers accurately, simply and conveniently.

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LCD BARCODE SCANNER WITH CAPABILITY OF SCANNING LCD BARCODE

Technical Field

The present invention relates in general to scanner systems for recognizing barcodes displayed on liquid crystal displays (LCDs) of mobile terminals such as a cellular phone, PDA and pager, and more particularly to an LCD barcode scanner which is capable of scanning and decoding customer information displayed on LCDs of mobile terminals in the form of barcodes, thereby identifying customers accurately, simply and conveniently.

Background Art

Generally, a barcode is prescribed to be a single character by the combination of a plurality of black and white bars having different thicknesses in a specific ratio, and a device for reading and decoding the barcode is called a barcode scanner.

Such barcodes have widely been used in supermarkets or large-scale stores to indicate the prices of commodities. A barcode writer must first be provided for management of commodities based on barcodes. Barcodes are printed and attached to associated commodities. When a specific commodity is purchased by a customer, its price can be checked by scanning a barcode attached thereto. As a result, the use of barcodes enables associated information to be

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simply and conveniently checked within a brief period of time.

For this reason, for customer identification in department stores or large-scale stores, cards having barcodes for customer identification written thereon are more often used than a method of entering names and resident registration numbers of customers one by one.

Recently, studies have been actively conducted of the application of barcodes to membership management systems based on the Internet.

However, the application of conventional barcodes to Internet membership management systems has the following problems.

Firstly, it is impossible to preserve printed barcodes for a lengthy period of time. Namely, if a printed barcode is repeatedly scanned, it cannot continuously maintain its original shape, which may lead to the occurrence of an error in data recognition. For management of members on the Internet using such printed barcodes, the barcodes increase in the number of uses as time goes by, resulting in the inconvenience of having to replace them with new ones within a short time after they are attached. Further, whenever barcodes are replaced, the customers' identities must be verified, resulting in a complexity in membership management.

Secondly, the use of conventional printed barcode scanners makes it impossible to modify data of barcodes themselves. For management of members on the Internet using

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printed barcodes, barcode contents of customers must be able to be modified. In spite of this fact, the barcode contents of the customers cannot be modified by the transfer of data over networks. For this reason, each time the barcode
5 contents of the customers are modified, the, associated printed barcodes must be replaced with new ones, resulting in the inconvenience of use. In future, barcodes are expected to be of various types such as a liquid crystal display (LCD) type as well as a print type so that they can be continuously
10 used. In this regard, the conventional printed barcode scanners have a disadvantage in that they cannot decode LCD-type barcodes.

Thirdly, customers have to carry printed barcodes for Internet membership management separately from cellular
15 phones. This causes the customers an inconvenience of use.

In order to overcome the above problems, there is a need for a method capable of displaying customer identification information as barcodes on LCDs of mobile
20 terminals such as a cellular phone, PDA and pager. This in turn requires an LCD barcode scanner capable of scanning the barcodes displayed on the LCDs of the mobile terminals.

Further, conventional scanners must comprise an RC
25 signal generator for generating a signal to drive a charge coupled device (CCD) sensor, and a sample/hold circuit for setting synchronization of the signal generation, resulting in an oscillation circuit and a frequency divider being in

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turn required. As a result, the conventional scanners are complex in construction and occupy large areas, thereby increasing the cost and making the precise control difficult.

Disclosure of the Invention

5   Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a liquid crystal display barcode scanner which is capable of scanning and decoding customer information displayed on liquid crystal displays of mobile 10   terminals in the form of barcodes, thereby identifying customers accurately, simply and conveniently.

In accordance with the present invention, the above and other objects can be accomplished by the provision of a 15   liquid crystal display barcode scanner comprising a trigger switch for starting a barcode scanning operation of the scanner; a memory for storing firmware for control of respective components in the scanner; a microprocessor for controlling the operations of the respective components in 20   the scanner according to the firmware stored in the memory, the microprocessor adapted to control light emission and barcode signal detection operations in response to a switching operation of the trigger switch, decode liquid crystal display barcode information inputted thereto and 25   control the transfer of the decoded barcode information to an external unit; a light source including a light emitting

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diode for emitting light of a red wavelength to a liquid crystal display barcode to be scanned, under the control of the microprocessor; a lens/optical filter for condensing light reflected from the liquid crystal display barcode; a charge coupled device sensor for converting the intensity of the light condensed by the lens/optical filter into an electrical signal; a signal detector for amplifying an analog signal from the charge coupled device sensor, converting the amplified analog signal into a digital signal and outputting the converted digital signal to the microprocessor; and an input/output driver for transferring the barcode information decoded by the microprocessor to the external unit under the control of the microprocessor.

Brief Description of the Drawings

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram showing the construction of a liquid crystal display barcode scanner in accordance with the present invention;

Fig. 2 is a waveform diagram illustrating liquid crystal display barcode information and digital signals corresponding thereto; and

Fig. 3 is a view showing the outer appearance of the liquid crystal display barcode scanner of Fig. 1.

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Best Mode for Carrying Out the Invention

        This invention provides a liquid crystal display (LCD)
barcode scanner capable of decoding barcodes displayed on
5   LCDs of mobile terminals such as a cellular phone, PDA and
pager as well as existing printed barcodes such that it is
applicable to Internet services based on wireless networks.
Differently from existing printed barcode scanners, the
contents of barcodes displayed on LCDs of mobile terminals
10 such as a cellular phone, PDA and pager can be modified over
wireless networks at any time because the barcodes are able
to be decoded by the present LCD barcode scanner. This LCD
barcode scanner is applicable to Internet customer management
systems using customer management cards, coupons, tickets and
15 the like.

        With reference to Fig. 1, there is shown in block form
the construction of an LCD barcode scanner in accordance with
the present invention. As shown in this drawing, the LCD
20 barcode scanner comprises a trigger switch TSW for starting a
barcode scanning operation of the scanner, a memory 10 for
storing firmware for control of respective components in the
scanner, and a microprocessor 20 for controlling the
operations of the respective components in the scanner
25 according to the firmware stored in the memory 10. The
microprocessor 20 is adapted to control light emission and
barcode signal detection operations in response to a
switching operation of the trigger switch TSW, decode LCD

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barcode information inputted thereto and control the transfer of the decoded barcode information to an external unit. The LCD barcode scanner further comprises a light emitting diode (LED) light source 30 for emitting light of a red wavelength (660nm) to an LCD barcode to be scanned, under the control of the microprocessor 20, a lens/optical filter 40 for condensing light reflected from the LCD barcode, a charge coupled device (CCD) sensor 50 for converting the intensity of the light condensed by the lens/optical filter 40 into an electrical signal, a signal detector 60 for amplifying an analog signal from the CCD sensor 50, converting the amplified analog signal into a digital signal and outputting the converted digital signal to the microprocessor 20, and an input/output (I/O) driver 70 for transferring the barcode information decoded by the microprocessor 20 to the external unit under the control of the microprocessor 20.

The memory 10 is a storage unit for storing firmware used in this invention. For the purpose of solving a limitation in the accurate expression of a barcode (based on a thickness ratio) resulting from a minimum display resolution (a one dot unit) of an LCD, the firmware is used to program a compensation function for calculation of bar widths of the barcode. In a feature of the firmware of the present invention, for a barcode expressed in two columns due to a limited width of an LCD of a mobile terminal, both the first and second columns can be read and transferred to a computer. In another feature of the present invention, the

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firmware has a maintenance function and test function of the present invention so that a user can not only simply maintain the scanner but also a developer can readily test the scanner when a new function is additionally provided.

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The microprocessor 20 functions to monitor an output signal from the trigger switch TSW when the user starts to scan and to display the current state of the scanner on a display unit 100 to inform the user of that state. The

10   microprocessor 20 further functions to generate a signal for control of the LED light source 30 and a pulse signal for CCD control. Also, the microprocessor 20 is adapted to decode a digital signal from the signal detector 60, corresponding to a barcode, and transfers the decoded result to a computer or

15   host unit.

The LED light source 30 functions to emit light of a red wavelength (660nm) to a barcode in response to a control signal generated from the microprocessor 20 when the user pushes the trigger switch TSW to scan the barcode.

20   The lens/optical filter 40 functions to condense light reflected from a barcode displayed on an LCD of a mobile terminal such as a cellular phone, PDA and pager as well as a barcode printed on paper. The lens/optical filter 40 further functions to remove noise components from light reflected

25   from a given barcode.

Generally, scanners can receive light reflected from an object in two methods, one being a contact method wherein a

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window rubber is brought into contact with the object and the other being a noncontact (long-range) method wherein the window rubber is not brought into contact with the object. The present invention employs the noncontact method in that the object, or barcode, is projected under a protective film of an LCD of a mobile terminal such as a cellular phone, PDA and pager. On the other hand, the present scanner may have a limitation in accurately expressing a given barcode (on the basis of a thickness ratio), due to light reflection by an LCD protective film, LCD backlight, a surface reflectivity of the LCD and a minimum display resolution (a one dot unit) of the LCD. In order to overcome this limitation, the present invention employs the noncontact method to compensate for a distance between the scanner and the object (to secure the margin of a DOF (Depth of Field)). Further, this invention enhances the condensing capability of a lens (with respect to a light source and a CCD sensor).

The CCD sensor 50 functions to convert the intensity of the light condensed by the lens/optical filter 40 into a voltage level in such a manner that it generates current of a high voltage level for each white bar of an LCD barcode because it reflects a large amount of light, and little current for each black bar of the LCD barcode because it absorbs emitted light. A two-phase clock signal and four control signals (pulses) are necessary for the operation of the CCD sensor 50. In the present invention, these signals are generated under the control of the microprocessor 20.

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The CCD sensor in this invention is advantageous in that it is uniform in sensing characteristic and can receive barcode information under the condition of noncontact with an object, because it has a large number of photodiodes arranged on the
5   X axis.

The signal detector 60 functions to convert a weak electrical signal from the CCD sensor 50 into a digital signal using an analog amplifier and an electrical filter.
10 The analog amplifier may preferably include an operational amplifier (OP AMP). The electrical filter is adapted to remove electrical noise components generated during the optical/electrical conversion by the CCD sensor. For classification of the resulting electrical signal from the
15 electrical filter into two digital levels (+5V and 0V), the signal detector 60 digitalizes the electrical signal to +5V if it is higher than or equal to a reference voltage and 0V if it is lower than the reference voltage, so that such digital signals can be monitored by the microprocessor 20.
20   The I/O driver 70 functions to transfer the barcode contents decoded by the microprocessor 20 to a personal computer (PC) or host unit via a keyboard (K/B) or RS-232C interface.

In the LCD barcode scanner of the present invention,
25 the microprocessor 20 further functions to control the output of a specific sound and specific light whenever the barcode scanning operation is completed. The LCD barcode scanner further comprises a completion sound output unit 80 for

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outputting a specific sound indicative of the barcode scanning completion, and a completion light output unit 90 for outputting specific light indicative of the barcode scanning completion.

5   The LCD barcode scanner further comprises a display unit 100 for displaying the scanning state of the scanner on a screen. The microprocessor 20 controls the display unit 100 to display information relating to the scanning state of the scanner.

10   Fig. 2 is a waveform diagram illustrating LCD barcode information and digital signals corresponding thereto. As shown in this drawing, a barcode consists of alternating gray bars (or white bars) and black bars having a predetermined thickness ratio to express the contents of the barcode.

15   Fig. 3 is a view showing the outer appearance of the LCD barcode scanner of Fig. 1. As shown in this drawing, the trigger switch TSW is installed on the external surface of the LCD barcode scanner to provide a trigger signal to the microprocessor 20 in the scanner so as to start the scanning
20   operation of the scanner.

A detailed description will hereinafter be given of the operation of the LCD barcode scanner with the above-stated construction in accordance with the present invention with
25   reference to Figs. 1 to 3.

First, if the user pushes the trigger switch TSW installed on the external surface of the scanner, then the microprocessor 20 in the scanner recognizes the pushed state

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of the trigger switch TSW and controls the operations of the respective components including the LED light source 30.

The LED light source 30 emits light of a red wavelength (660nm) to an LCD barcode to be scanned, under the control of the microprocessor 20. Then, the light emitted to the barcode is reflected therefrom at an intensity corresponding to information contained in the barcode. The reflected light is condensed by the lens/optical filter 40 and transferred to the CCD sensor 50.

The CCD sensor 50 converts a weak optical signal transferred by the lens/optical filter 40 into an electrical analog signal and feeds the converted analog signal to the signal detector 60. The signal detector 60 amplifies the analog signal from the CCD sensor 50 by a predetermined level, converts the amplified analog signal into a digital signal decodable by the microprocessor 20 and outputs the converted digital signal to the microprocessor 20.

Upon receiving the digital signal from the signal detector 60, the microprocessor 20 decodes it and provides the decoded data to the I/O driver 70 for its transfer to an external unit. Thereafter, the I/O driver 70 transfers the decoded data of the LCD barcode to the external unit.

Namely, the decoded barcode data is transferred to a computer or host unit over a signal line connected to the tail of the scanner. Notably, the mobility of the scanner

must be assured. To this end, in the present invention, the scanner has a Bluetooth function to transfer barcode data wirelessly to the computer or host unit. This Bluetooth function can solve a distance limitation between the scanner

5   and the host computer, thereby enabling the transfer of data of a barcode displayed on an LCD of a remote mobile terminal such as a cellular phone, PDA and pager to the host computer.

On the other hand, in the case where the decoding of a

10   given barcode is completed with no error, the microprocessor 20 controls the output of a completion sound when the barcode scanning operation is completed. As a result, the completion sound output unit 80 outputs a specific sound indicative of the barcode scanning completion, for example, "whistling"

15   under the control of the microprocessor 20. Further, in the case where the decoding of the given barcode is completed with no error, the microprocessor 20 controls the output of completion light when the barcode scanning operation is completed. As a result, the completion light output unit or

20   indicator 90, which may be, for example, a light emitting diode installed on the head of the scanner, outputs specific light indicative of the barcode scanning completion, for example, "green light" or "red light" under the control of the microprocessor 20. Therefore, upon completing the

25   barcode scanning operation, the LCD barcode scanner of the present invention turns on/off light for a short time with whistling, so that the user can easily recognize the completion of the scanning operation.

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Industrial Applicability

As apparent from the above description, the present invention provides a liquid crystal display (LCD) barcode scanner having effects summarized as follows.

Firstly, the LCD barcode scanner can decode barcodes displayed on LCDs of mobile terminals such as a cellular phone, PDA and pager as well as printed barcodes. The merit of the LCD barcodes can reduce an error rate upon repetitive use.

Secondly, the scanning of barcodes on LCDs of mobile terminals enables the writing of barcodes through the Internet. Therefore, the LCD barcode scanner is applicable to customer management systems based on the Internet.

Thirdly, the decoding of barcodes on LCDs of mobile terminals makes it convenient for customers to carry the barcodes.

Fourthly, the decoding of LCD barcodes using a Bluetooth function enables the scanning of barcodes at a place distant from a host computer. As a result, a user of the scanner can readily check through an LCD of a mobile terminal of a customer whether the customer is a member, even though the customer is away from the host computer.

Fifthly, this LCD barcode scanner is applicable to Internet customer management systems using customer management cards, coupons, tickets and the like, in that it can decode barcodes on LCDs of mobile terminals.

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Although the preferred embodiments of the LGOWNJpresent invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, 5 without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

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Claims:

1. A liquid crystal display barcode scanner comprising:

a trigger switch for starting a barcode scanning operation of the scanner;

a memory for storing firmware for control of respective components in said scanner;

a microprocessor for controlling the operations of the respective components in said scanner according to said firmware stored in said memory, said microprocessor adapted to control light emission and barcode signal detection operations in response to a switching operation of said trigger switch, decode liquid crystal display barcode information inputted thereto and control the transfer of the decoded barcode information to an external unit;

a light source including a light emitting diode for emitting light of a red wavelength to a liquid crystal display barcode to be scanned, under the control of said microprocessor;

a lens/optical filter for condensing light reflected from said liquid crystal display barcode;

a charge coupled device sensor for converting the intensity of the light condensed by said lens/optical filter into an electrical signal;

a signal detector for amplifying an analog signal from said charge coupled device sensor, converting the amplified analog signal into a digital signal and outputting the converted digital signal to said microprocessor; and

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an input/output driver for transferring the barcode information decoded by said microprocessor to said external unit under the control of said microprocessor.

2. A liquid crystal display barcode scanner as set forth in Claim 1, further comprising:

a completion sound output unit for outputting a specific sound indicative of barcode scanning completion; and

a completion light output unit for outputting specific light indicative of the barcode scanning completion;

said microprocessor further adapted to control the output of said specific sound and specific light from said completion sound output unit and completion light output unit whenever said barcode scanning operation is completed.

3. A liquid crystal display barcode scanner as set forth in Claim 1, further comprising a display unit for displaying a scanning state of said scanner on a screen, said microprocessor further adapted to control said display unit to display information relating to the scanning state of said scanner.
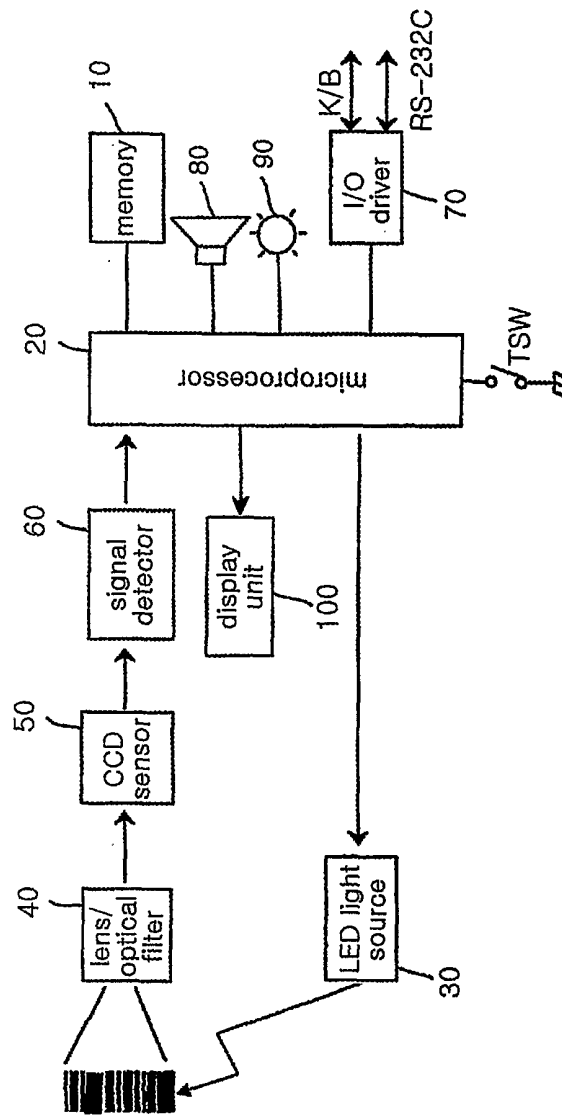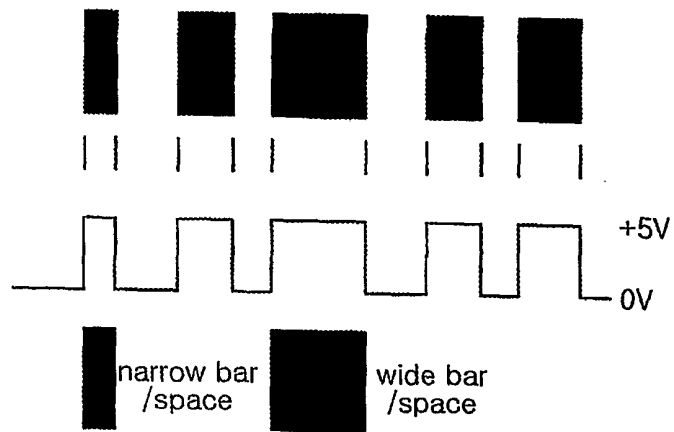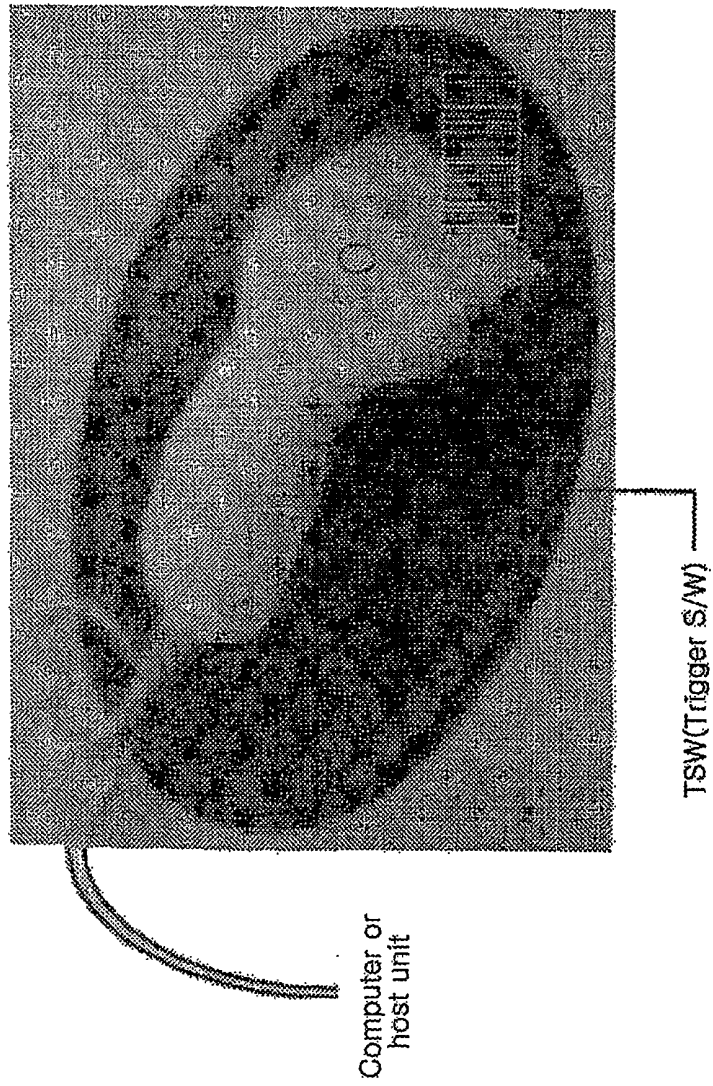
1/3

FIG. 1

2/3

narrow bar
/space

wide bar
/space

+5V

0V

FIG. 2

3/3

Computer or host unit

TSW(Trigger S/W)

FIG. 3

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G06K 7/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimun documentation searched (classification system followed by classification symbols)

IPC G06K

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

KR, JP, US IPC as above

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)
KIPONET

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5003251A(GRUMMAN AEROSPACE CORPORATION) 26 March, 1991 See the whole document	1-3
A	JP 62-5430A2(STANLEY ELECTRIC CO LTD) 12 January, 1987 See the whole document	1-3
A	JP 05-233867A2(OLYMPUS OPTICAL CO LTD) 10 Sep.tember, 1993 See the whole document	1-3
A	US 5789732A(PORTABLE DATA MODULE AND SYSTEM FOR CONSUMER TRANSACTIONS) 04-August, 1998 See the whole document	1-3

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevence "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevence; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevence; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 JULY 2001 (13.07.2001)	13 JULY 2001 (13.07.2001)

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Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5981

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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