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(54) Title: AUTOMATIC BARCODE CREATION FOR DATA TRANSFER AND RETRIEVAL
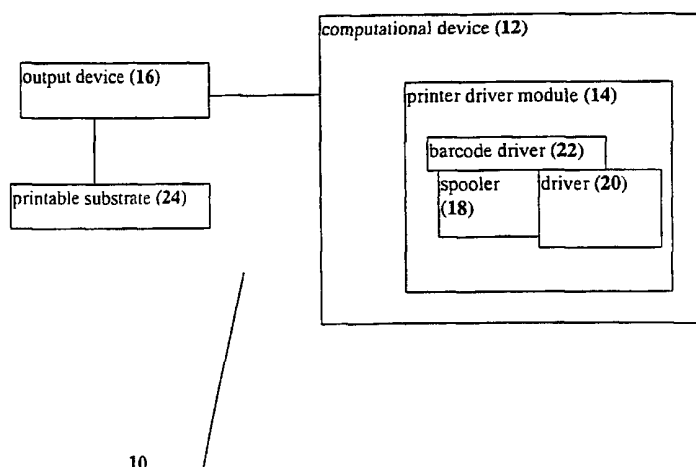
(57) Abstract: A system and a method for automatically analyzing and reading a barcode present in an electronically stored and transferred file, and/or printed on a printable substrate, such as a sheet of paper. Such a barcode can be used to store a large amount of information in a small area. Various uses of the disclosed system and method are possible. For example in order to authenticate and/or identify a document. In addition, such a barcode could be used to transmit information which could be automatically read and analyzed. This provides a single solution to the combined problems of data authentication and verification for electronically stored and transferred data, as well as of automatic reading and data analysis of data printed on a printable substrate. Although the implementation in which the data is printed onto paper or other physical substrate material is particularly preferred, the overall flexibility of the disclosed system and method enable them to be employed in a variety of embodiments.

AUTOMATIC BARCODE CREATION FOR DATA TRANSFER

AND RETRIEVAL

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FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a system and a method for automatically

printing a barcode on paper or other printer substrate, and in particular, to such a

printed barcode for data transfer and/or capture.

10   Although a significant amount of data is transferred electronically, the

requirement for paper still exists. Businesses today receive and send data of many

different types on paper, including invoices. receipts, purchase requests, forms of

various kinds. reports and so forth. The paper itself may be transferred by mail or

by facsimile, for example. When transferred by facsimile, the quality of the

15   resultant text and/or graphics may be degraded. Furthermore, the facsimile

machine and/or printer may not place the text or graphics in exactly the same

location on the paper every time. All of these factors combine to render the

automatic reading and analysis of data from printed paper very difficult and

frequently inaccurate. For example, OCR (optical character recognition) of a

20   scanned sheet of paper requires good quality reproduction of the textual data in

order to obtain an accurate analysis of the printed text. Such high quality is often

difficult to obtain from a facsimile, for example. Thus, a human worker often must

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read each sheet of printed paper and transfer the data manually to a computer, which is highly inefficient.

However, paper does have certain advantages over completely electronic forms of data transfer. Even though attempts have been made to provide an

5   electronic "signature" or "watermark", or other form of verification for electronically stored and transferred data, none of these attempts has resulted in such a verification which is as accurate and as reliable as the manually written signature of a human being on a sheet of paper. Thus, electronically transferred data may be easier to automatically read and analyze, without the intervention of a

10   human worker, but suffers from the inability to guarantee the authenticity of the data.

A more useful solution would both enable data to be accurately and automatically read and analyzed from a sheet of printed paper, without the intervention of a human worker, and would also provide a mechanism for

15   guaranteeing the authenticity of data which is stored and transferred electronically without being printed onto paper or other printable substrate. Currently, neither problem is adequately solved by the background art, and certainly the combination of both problems is not solved by a single background art solution.

There is thus a need for, and it would be useful to have, a system and a

20   method for enabling data to be automatically read and analyzed from a printed sheet of paper or other printable substrate, even if the quality of the data is degraded by poor reproduction such as by a facsimile machine, for example, and

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which would also be suitable for guaranteeing the authenticity of electronically

stored and transferred data.

SUMMARY OF THE INVENTION

5   The present invention is of a system and a method for automatically

analyzing and reading a barcode present in an electronically stored and transferred

file. and/or printed on a printable substrate, such as a sheet of paper. Such a

barcode can be used to store a large amount of information in a small area.

Various uses of the system and method of the present invention are possible. for

10   example in order to authenticate and/or identify a document. In addition, such a

barcode could be used to transmit information which could be automatically read

and analyzed.

The present invention provides a single solution to the combined problems

of data authentication and verification for electronically stored and transferred data.

15   as well as of automatic reading and analysis of data printed on a printable substrate.

Although the implementation of the present invention in which the data is printed

onto paper or other physical substrate material is particularly preferred, the overall

flexibility of the present invention enables it to be employed in a variety of

embodiments.

20   According to the present invention, there is provided a system for printing a

barcode onto a printable substrate, the barcode featuring a pattern of a plurality of

marks, the system comprising: (a) an output device for receiving a plurality of

printing commands and for printing a printable substrate according to the plurality of printing commands; (b) a computational device for receiving data to be printed; and (c) a printer driver module for being operated by the computational device and for translating at least a portion of the data to be printed into the barcode, and for

5   determining at least one command for printing the barcode onto the printable substrate to form a printed barcode, the printer driver module passing the at least one command to the output device.

According to another embodiment of the present invention, there is provided a method for printing a barcode onto a printable substrate, the method comprising

10   the steps of: (a) receiving data; (b) translating at least a portion of the data into a pattern of a plurality of marks; (c) determining at least one printing command for printing the pattern of the plurality of marks; and (d) printing the pattern of the plurality of marks onto the printable substrate to form the barcode.

Hereinafter, the term "printable substrate" refers to any type of material

15   onto which text and/or graphics can be printed, for example by a laser printer or an ink jet printer. Examples of such a substrate include but are not limited to a sheet of paper, cardboard or other wood pulp-based product, plastic and metal.

Hereinafter, the term "network" refers to a connection between any two computers which permits the transmission of data, and includes but is not limited

20   to, the Internet, a WAN (Wide Area Network) and a LAN (Local Area Network).

Hereinafter, the term "computer" includes, but is not limited to, personal computers (PC) having an operating system such as DOS, Windows™, OS/2™ or

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Linux; Macintosh™ computers; computers having JAVA™-OS as the operating

system; and graphical workstations such as the computers of Sun Microsystems™

and Silicon Graphics™, and other computers having some version of the UNIX

operating system such as AIX™ or SOLARIS™ of Sun Microsystems™; or any

5   other known and available operating system; as well as a terminal or any

computational device containing a microprocessor. Hereinafter, the term

"Windows™" includes but is not limited to Windows95™, Windows 3.x™ in

which "x" is an integer such as "1", Windows NT™, Windows98™, Windows

CE™ and any upgraded versions of these operating systems by Microsoft Inc.

10   (USA).

The method of the present invention could also be described as a plurality of

instructions being performed by a data processor, such that the method of the

present invention could be implemented as hardware, software, firmware or a

combination thereof. For the present invention, a software application could be

15   written in substantially any suitable programming language, which could easily be

selected by one of ordinary skill in the art. The programming language chosen

should be compatible with the computer by which the software application is

executed. Examples of suitable programming languages include, but are not

limited to, C, C++ and Java.

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BRIEF DESCRIPTION OF THE DRAWINGS

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The foregoing and other objects, aspects and advantages will be better

understood from the following detailed description of a preferred embodiment of

the invention with reference to the drawings, wherein:

FIG. 1 is a schematic block diagram of an illustrative barcode printing

5   system according to the present invention; and

FIG. 2 is a schematic block diagram of an illustrative barcode scanning

system according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

10   The present invention is of a system and a method for automatically

analyzing and reading a barcode present in an electronically stored and transferred

file, and/or printed on a printable substrate, such as a sheet of paper. Such a

barcode can be used to store a large amount of information in a small area.

Various uses of the system and method of the present invention are possible, for

15   example in order to authenticate and/or identify a document. In addition, such a

barcode could be used to transmit information which could be automatically read

and analyzed.

The present invention provides a single solution to the combined problems

of data authentication and verification for electronically stored and transferred data,

20   as well as of automatic reading and analysis of data printed on a printable substrate.

Although the implementation of the present invention in which the data is printed

onto paper or other physical substrate material is particularly preferred, the overall

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flexibility of the present invention enables it to be employed in a variety of
embodiments.

The principles and operation of a system and method according to the
present invention may be better understood with reference to the drawings and the

5   accompanying description, it being understood that these drawings are given for
illustrative purposes only and are not meant to be limiting.

Referring now to the drawings, Figure 1 is an exemplary block diagram of
an illustrative system according to the present invention. A system 10 features a
computational device 12 for operating software programs. Computational device

10   12 is typically a computer as defined above. Optionally and preferably,
computational device 12 is any type of electronic device with an embedded
operating system and a microprocessor, for example. For the purposes of
description only and without intending to be limiting in any way, computational
device 12 is assumed to be a computer.

15   Computational device 12 operates a printer driver software module 14 for
enabling received data to be printed to an output device 16. Printer driver software
module 14 is able to receive data and to manipulate this data into a format which
can be printed to output device 16. Printer driver software module 14 includes a
spooler 18 and a driver 20, as is known in the background art. The received data

20   contains a number of commands which instruct printer driver software module 14
for printing the data. Driver 20 translates these commands for spooler 18, which in
turn communicates with output device 16 for printing the data. The

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implementation of spooler 18 and driver 20 are both well known in the art and could easily be performed by one of ordinary skill in the art.

Printer driver software module 14 also features an additional module, which is a barcode driver 22 and which is not known in the background art. Barcode driver 22 examines the received data to be printed, and adds commands which are translatable by driver 20, such that spooler 18 also instructs output device 16 to print a barcode in addition to the received data, or alternatively and preferably in place of the received data.

As used herein, the term "barcode" refers to a two or three dimensional printed barcode, in which the third dimension is color, as disclosed for example in U.S. Patent No. 5,304,786, incorporated by reference as if fully set forth herein. The disclosed two dimensional barcode features a plurality of symbols, which are determined according to a code and hence which can be decoded in order to obtain the information contained within the barcode. Such a barcode has a high capacity for information storage in a relatively small area. The barcode of U.S. Patent No. 5,304,786 is able to store 1 kilobyte of memory in an area of a few square inches of printed substrate material. Thus, a large amount of information can be stored in place of, or in addition to, the initial received data.

The barcode of U.S. Patent No. 5,304,786 is one example of such a barcode for use with the present invention, although other such barcodes could also be used. This barcode has a structure for containing the groups of symbols, or "codewords". Each codeword is a pattern of a plurality of elements or marks, which can be of

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varying height or of a relatively uniform low height. Each mark pattern must

conform to certain rules. such that the codeword belongs to a particular family or

set of mark patterns. The codewords are arranged in rows, such that neighboring

rows contain codewords from different sets of mark patterns. Therefore, if a row

5   crosses another row, which could prove detrimental to the decoding of the row of

codewords. such a cross can be quickly detected. Furthermore, scanning the

barcode is more easily performed, which is particularly useful for the present

invention, which contemplates scanning of such barcodes with little or no manual

intervention by a human operator.

10   Other examples of barcode technologies which are useful with the present

invention include, but are not limited to, those disclosed in U.S. Patent Nos.

5.313.564 and 5,801,848, both of which are incorporated by reference as if fully set

forth herein.

Since a barcode is a pattern of symbols, barcode driver 22 must translate the

15   received data into such symbols in order to determine the commands to be given to

driver 22. For example, barcode driver 22 could first separate the received data

into text and graphics, by separating commands concerning the fonts, the position

of the text and the text itself from the other commands, such as page printer

commands, for the graphics themselves and for position of the graphics. Data

20   obtained from these other commands, such as for the graphics, are optionally

included in the barcode.

Next, the text could be parsed into a plurality of words, while the graphics , if included, could be separated into separate graphical items, determined for example according to the boundary between text and each graphical item. At least a portion of the words of the text could then be translated into a codeword or

5   codewords. For example, if the received data pertains to an invoice, at least the important information, such as the name of the receiving company for example, is preferably translated into codewords. A description of the visual appearance of each graphical item could also optionally be translated into codewords.

Optionally and preferably, if the received data contains a printer command

10   concerning a "remark" which is not to be printed, barcode driver 22 could retrieve the field name from the "remark" and could use this information to identify the following printed field. The field name could then be used by the scanning module (see Figure 2 below) to identify the type of field, rather than relying only on position on the sheet of paper or other characteristics. Also optionally and

15   preferably, barcode driver 22 would include specific user information in the barcode, such as the identity of the user, a password for the user and more preferably the date of printing, or other user information.

Barcode driver 22 could then determine the necessary command or commands for instructing spooler 18 to print these codewords through output

20   device 16. For example, barcode driver 22 could determine where on the page the barcode is to be printed, and how portions of the barcode which do not fit on one

page should be treated. For example, barcode driver **22** could optionally cause the barcode to be printed over a plurality of pages, if necessary.

Output device **16** is optionally and preferably a printer, such as a laser printer, a thermal printer or an inkjet printer for example, or even a facsimile

5　machine, which prints the information to a printable substrate **24**. In this context, printable substrate **24** is a material to which the printer is capable of applying ink, dye or other marking substance, or otherwise causing markings to appear on the material, in order to produce the barcode for describing the received information, such as paper, metal or plastic for example. Alternatively and preferably, output

10　device **16** is an electronic storage medium, such as a magnetic or optical storage medium. In this context, printable substrate **24** is actually an electronic file which contains all of the description of the commands and instructions for printing the barcode alone, or barcode with the received data, to a substrate such as paper for example. This file could then optionally be read directly by spooler **18** for printing

15　on the same type of printer as the printer command language which was originally used, although the file could be also optionally be converted to another printer command language for printing on a different type of printer. The file could also be translated to a file type which is readable by other software programs, such as by word processing programs for example, particularly if the file is an EMF file.

20　Both types of "printing" to printable substrate **24**, whether to a substrate such as paper or to an electronic file, are contemplated within the present invention.

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One illustrative example of a method for printing the barcode, either alone

or with the received data, is a method for directing a laser printer to print the

information to paper by a computer operating according to a version of the

Windows™ operating system (Microsoft Ltd.), such as Windows 95™, Windows

5   98™ or NT 4 for example. A printer driver software module in one of these

operating systems is typically able to perform either raw printing or EMF printing.

EMF (extended metafile) printing involves determining the appropriate GDI

(graphics device interface) commands for printing the information. These GDI

commands are then stored in an EMF file. The spooler then reads this spool file,

10   and translates the GDI commands into raw print commands by using the printer

driver. Thus, if all of these commands are copied into an electronic file, the

resultant file could be used to print the barcode or other information.

Therefore, in this example the printer driver software module of the present

invention, and more particularly the barcode driver, preferably translates at least a

15   portion of the received data into the GDI commands for being printed as the

barcode. These GDI commands would be used in this example to determine the

visual appearance of the codewords, such that the resultant barcode would have the

correct pattern when printed on a sheet of paper for example. In addition, the EMF

file could be inserted into another electronic file, such as a word processing file for

20   example, in order to provide identification and authentication through a watermark

for example.

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Other examples of printing command languages which are suitable for use

with the present invention include but are not limited to PostScript™ (Adobe

Research Ltd.), PCL™ (Hewlett Packard Ltd.), CAPSL™ (Canon Ltd.), PPL™

(Digital Ltd.), all versions of these languages, as well as other printer command

5   languages.

Figure 2 shows a scanning system 26 for automatically reading and

analyzing the barcode when printed onto a printable substrate such as a sheet of

paper. for example. Scanning system 26 includes a scanning unit 28 for detecting

the barcode on the printable substrate. Scanning unit 28 optionally and preferably

10   features a laser light source 30 for generating a laser beam which is directed toward

the printable substrate containing the barcode. Reflected light is then received by a

light detector 32. Signals from light detector 32 are passed to a computational

device 34, which may be similar to the computational device of Figure 1.

Other possible embodiments for scanning unit 28 include but are not limited

15   to a flatbed scanner or other types of scanning devices, and a CCD (charge-coupled

device) cameras, or video capturing systems.

Computational device 34 operates a signal analysis module 36, which

analyzes the received signals from the reflected light in order to obtain the

information from the barcode. If the barcode is as disclosed in U.S. Patent No.

20   5,304,786, then the method for analysis and decoding which is disclosed therein is

optionally used in signal analysis module 36. According to U.S. Patent No.

5,304,786, the barcode is preferably decoded in a two step process. In the first

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step, the set of the codeword is determined according to a discriminator function.

In the second step, the symbolic meaning assigned to the codeword is determined

from a mathematical function, for example from a look-up table. Error detecting

and correcting functions are optionally performed. Thus, the content of the

5   information encoded by the barcode is preferably determined according to a

process which is able to handle degraded or imperfectly transmitted barcode data.

Such an ability is particularly important for a number of different preferred

embodiments of the present invention. For example, the system and method of the

present invention could be used for transmitting information by facsimile. Such

10   transmission is frequently imperfect and/or produces received data of degraded

quality. Thus, the method and system of the present invention are preferably

implemented with a barcode which is resistant to degradation of quality during

transmission.

In addition, the system and method of the present invention are useful for

15   the identification of the sender or author of a document, and/or for authentication

of the document source. For example, the system and method of the present

invention can be used to add a "watermark" to a printed document, which would

indicate the identity of the person who should receive it. Such a "watermark"

could also contain a password for an electronically stored and/or transmitted file,

20   which would be required in order for the information to be retrieved from the file,

for example.

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Other possible embodiments of the system and method of the present invention include for a device which would read data in an audible, electronically generated voice, for example for those individuals who have limited vision.

The location of the barcode on a sheet of paper can be adjusted as desired. particularly for the security and authentication embodiments described previously. For example, the barcode could be divided into a plurality of portions, with each portion appearing on one of a plurality of sheets of paper, thereby authenticating multiple pages of a document if not the entirety of the document. Alternatively. the entire barcode could be printed on one sheet of paper, and could be compared to the text and other information contained on that sheet for the purposes of authentication.

According to other preferred embodiments of the present invention. the functional modules described in Figures 1 and 2 can be implemented as hardware, firmware or a combination thereof, in addition to the described implementation as software modules. For example, the printer driver software module of Figure 1 is optionally implemented as a hardware device. Such a hardware device could be attached to the serial or parallel printer port, or other data ports such as a USB port, infrared port, GPAB port or SCSI port, or even a network card, such that data flowing from the computer to the printer would be intercepted by the printer driver hardware device. This hardware device would then add the barcode data, or optionally replace the data to be printed with the barcode data, such that at least the barcode data would be printed by the printer. Alternatively, the printer driver

hardware device could be implemented as a card, a SIMM or a DIMM, which would be connected to the bus on the printer. Also alternatively, the printer driver hardware device could be implemented as a chip which could be added to the printer itself and/or to the computer. If implemented as software, the software could be added to the system of the printer. In addition, the scanning module software could be added to the scanner system for operation by the scanner. Thus, the present invention can be implemented according to a number of different embodiments.

It will be appreciated that the above descriptions are intended only to serve as examples, and that many other embodiments are possible within the spirit and the scope of the present invention.

What is claimed is:

1.   A system for automatically printing a barcode onto a printable

substrate. the barcode featuring a pattern of a plurality of marks, the system

comprising:

(a)   an output device for receiving a plurality of printing commands and

for printing a printable substrate according to said plurality of

printing commands;

.(b)   a computational device for receiving data to be printed; and

(c)   a printer driver module for being operated by said computational

device and for automatically translating at least a portion of said data

to be printed into the barcode, and for automatically determining at

least one command for printing the barcode onto said printable

substrate to form a printed barcode, said printer driver module

passing said at least one command to said output device.

2.   The system of claim 1, wherein said printer driver module further

comprises:

(i)   a barcode driver for receiving said data to be printed, for analyzing

said data and for translating at least a portion of said data into the

pattern of the plurality of marks for determining the barcode;

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(ii)   a driver for receiving at least the pattern of the plurality of marks and

        for determining a plurality of printer commands for printing the

        pattern of the plurality of marks; and

(iii)   a spooler for receiving said plurality of printer commands and for

        translating said plurality of printer commands into instructions for

        said output device for printing.

·3.   The system of claim 2, wherein said output device is a printer for

printing onto a material selected from the group consisting of paper. metal and

plastic.

4.   The system of claim 3, wherein said printer driver module is

implemented as a hardware device for connecting said computational device to said

output device.

5.   The system of claim 3, wherein said printer driver module is

implemented as a hardware device for connecting only to said computational

device.

6.   The system of claim 3, wherein said printer driver module is

implemented as a software module.

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7.   The system of claim 1, further comprising:

(d)   a scanning system for reading said printed barcode and for retrieving

        said at least a portion of said data to be printed from said printed

        barcode.

8.   The system of claim 7, wherein said scanning system further

comprises:

(i)   a laser light source for reflecting a laser beam onto said printed

        barcode:

(ii)   a light detector for detecting reflected light from said printed barcode;

        and

(iii)   a signal analysis module for being operated by said computational

        device and for determining said at least a portion of said data to be

        printed from said printed barcode.

9.   A method for printing a barcode onto a printable substrate, the

method comprising the steps of:

(a)   receiving data;

(b)   translating at least a portion of said data into a pattern of a plurality of

        marks:

(c)   determining at least one printing command for printing said pattern of

        said plurality of marks; and

(d) printing said pattern of said plurality of marks onto the printable

substrate to form the barcode.

10. The method of claim 9, wherein said data features text, such that step

(b) comprises the steps of:

(i) dividing said text into a plurality of words; and

(ii) translating each word into a word pattern of a plurality of marks.

11. The method of claim 10, wherein said data further features at least

one graphical image, a boundary of said at least one graphical image being

determined according to said plurality of words, and step (b) further comprises the

step of:

(iii) translating said at least one graphical image into a pattern of a

plurality of marks.

12. The method of claim 11, wherein said printable substrate is selected

from the group consisting of paper, metal and plastic, and step (d) is performed by

printing a visible marking substance to said printable substrate.

13. The method of claim 12, wherein said printable substrate is a

document and the barcode contains information for authenticating a source of said
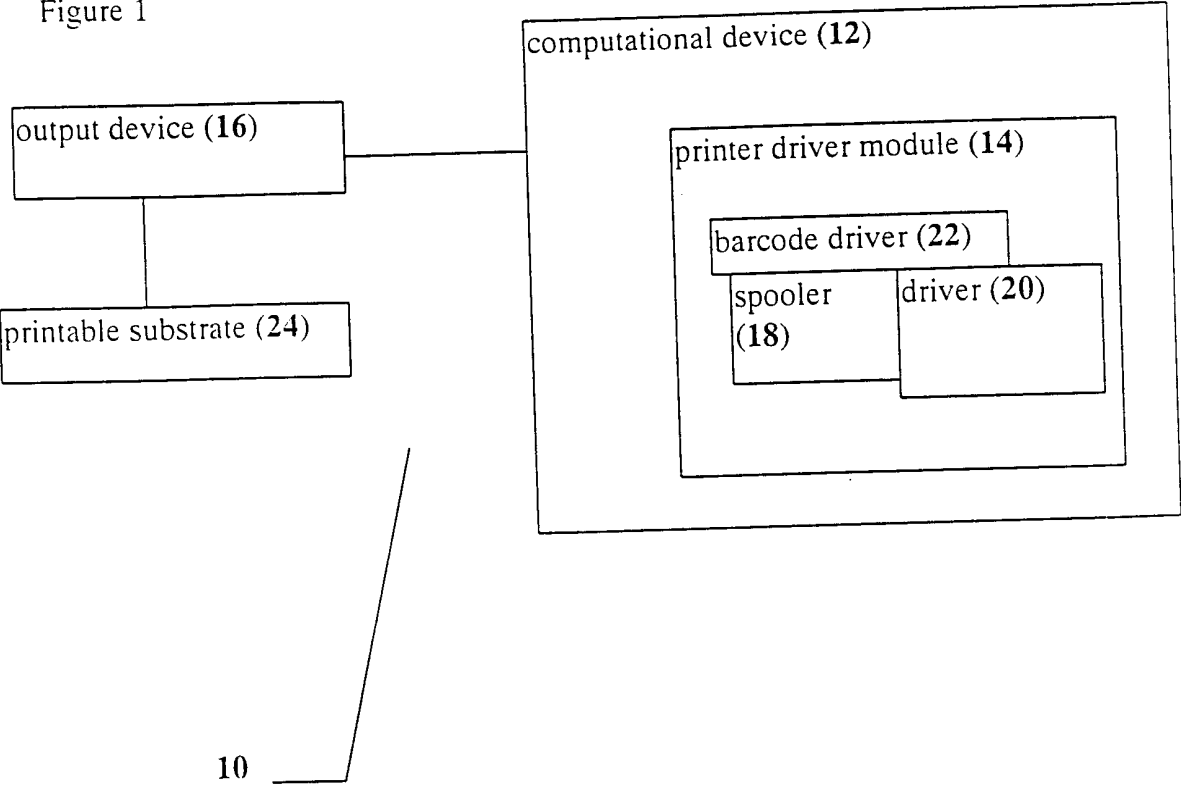
document.

Figure 1

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Figure 2