(54) AUTOMATIC AND TRANSPARENT ARCHIVING OF DOCUMENTS AND DOCUMENT INFORMATION

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(5) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/347,953

(22) Filed: Jul. 6, 1999

(65) Prior Publication Data


(63) Continuation of application No. 08/754,721, filed on Nov. 21, 1996, now Pat. No. 5,978,477.

(51) Int. Cl. .......................... G06F 12/00

(52) U.S. Cl. ......................... 358/1.15, 358/403, 358/444; 399/8, 707/204

(58) Field of Search ...................... 358/1.15, 402, 358/403, 407, 442, 443, 444, 468; 709/203, 206, 207, 219; 399/1, 8, 38, 79, 82, 83; 707/200, 204, 205

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ABSTRACT

An automatic archiving system that makes document archiving largely transparent to the user. In one embodiment, documents scanned in or printed during the course of office equipment operation are automatically archived. For example, an office local area network (LAN) may interconnect a copier, a printer, a fax machine, and a document management workstation. Whenever a document is copied, printed, or faxed, a document image is archived by the document management workstation without further user intervention. A single user command results in the document being copied and archived, printed and archived, or faxed and archived.

44 Claims, 8 Drawing Sheets
<table>
<thead>
<tr>
<th>Patent Number</th>
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<th>Inventor(s)</th>
<th>Classification</th>
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FIG. 4

3 Bits Laser Diode Power / 5 Bits Pulse Width Modulation

Scanner IPU
302A 302B

Pixel Data Out

Print Engine
304

To Controller 306

HSYNC 406

Vertical Synchronization Control

VSYNC 410

To Controller 306

Horizontal Synchronization Control

Laser Diode
Input Port

306
Document Insertion

Conversion of Formats and Indexing (CFI)

Encryption

"Infinite" Storage

Search and Retrieval Function Interface (SRI)

Decryption

Client Systems

FIG. 9
AUTOMATIC AND TRANSPARENT ARCHIVING OF DOCUMENTS AND DOCUMENT INFORMATION

STATEMENT OF RELATED APPLICATIONS

The present application is a continuation of and claims priority from U.S. patent application Ser. No. 08/754,721 filed Nov. 21, 1996 (which issued as U.S. Pat. No. 5,978,477), the entire contents of which are herein incorporated by reference for all purposes.

The present application is related to the subject matter of the application titled, “DOCUMENT MANAGEMENT SYSTEM” co-assigned with the present application and filed on the same day. The contents of the “DOCUMENT MANAGEMENT SYSTEM” application are herein incorporated by reference for all purposes.

BACKGROUND OF THE INVENTION

The present invention relates to a document management system and more particularly to providing automatic archiving to standard office equipment.

With the rapid development of storage system technology, the cost of storing an image of a sheet of paper on digital media has become less than the cost of printing and storing the sheet of paper itself. Digital document storage also facilitates later electronic search and retrieval and raises the possibility of automatic filing of documents.

Until now, systematic digital document storage has required user discipline to scan in each and every document for the express purpose of archiving. Work has been done to make stand-alone scanners less expensive, easier to use, and more compact. However, the user must still 1) remember that a document should be scanned, 2) locate a scanner, 3) bring the document to the scanner, and 4) operate the scanner. However, scanning occurs constantly in the office environment in the contexts of copying and faxing.

SUMMARY OF THE INVENTION

The present invention provides an automatic archiving system that makes document archiving largely transparent to the user. In one embodiment, documents scanned in or printed during the course of office equipment operation are automatically archived. For example, an office local area network (LAN) may interconnect a copier, a printer, a facsimile machine, and a document management workstation. Whenever, a document is copied, printed, or faxed, a document image is archived by the document management workstation without further user intervention. A single user command results in the document being copied and archived, printed and archived, or faxed and archived.

In accordance with a first aspect of the invention, a method for processing document images includes steps of receiving a single user input command and performing certain steps in response to the single user input command. The steps include scanning a document image to collect image data, printing the document image based on the image data, and sending the image data to an archiving system for storage.

In accordance with a second aspect of the invention, a method for printing and archiving documents includes steps of receiving a single user command requesting that a document be printed, printing the document in response to the single user command, and archiving image data representing the document in response to the single user command.

In accordance with a third aspect of the invention, a method for archiving documents to be faxed includes steps of receiving a single user command indicating that a document is to be faxed, scanning the document to be faxed in response to the single user command, transmitting first image data representing the document as scanned to a remote location via a public telephone network, and archiving, in response to the single user command, second image data representing the document as scanned in the scanning step.

In accordance with a fourth aspect of the invention, a computer installation includes a digital copier that scans in documents to be copied, a printer that prints documents, a computer system controlling a long-term storage medium, and a network interconnecting the digital copier, the printer, and the computer system. The digital copier relays image data representing the documents to be copied to the computer system for storage on the long-term storage medium. The printer, or a printer server controlling the printer, or a computer system initiating a command to print relays image data representing printed documents to the computer system for storage on the long-term storage medium.

In accordance with a fifth aspect of the invention, a digital copier includes a scanner that generates image data representing a document to be copied, an image processing unit that processes the image data to correct imaging errors introduced by the scan engine, a printer that copies the document responsive to the image data as processed by the image processing unit, and an image data tap that relays the image data to a storage system for archiving.

A further understanding of the nature and advantages of the inventions herein may be realized by reference to the remaining portions of the specification and the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts an office machine network implementing automatic document archiving in accordance with one embodiment of the present invention.

FIG. 2 depicts a portion of a copier control interface.

FIG. 3 depicts a top-level diagram of a digital copier implementing automatic document archiving in accordance with one embodiment of the present invention.

FIG. 4 depicts alternative signals usable for extracting horizontal synchronization data from a digital copier in accordance with one embodiment of the present invention.

FIG. 5 depicts a printer interface.

FIG. 6 depicts a facsimile machine interface.

FIG. 7 depicts a facsimile machine modified for automatic archiving in accordance with one embodiment of the present invention.

FIG. 8 depicts a computer system usable for implementing elements of the present invention.

FIG. 9 depicts a software architecture for operating a document image database in accordance with one embodiment of the present invention.

DESCRIPTION OF SPECIFIC EMBODIMENTS

Overall Architecture for Automatic Archiving

FIG. 1 depicts an office machine network implementing automatic document archiving in accordance with one embodiment of the present invention. A network 100 may be implemented in any way, e.g., an Ethernet. Network 100 interconnects a representative client system 102, a print server 104, a special digital copier 106, a document man-
management workstation 108, and a special facsimile machine 110. Print server 104 controls printing on a representative printer 112 at the request of client system 102 and relays document image data characterizing a document to document management workstation 108 for archiving. Digital copier 106 copies documents and transmits image data obtained during the course of copying to document management workstation 108 for archiving. Similarly, facsimile machine 110 captures image data during the course of sending and receiving documents and transmits the image data to document management workstation 108 for archiving. Document management workstation 108 collects the document image data collected from all of the office equipment and maintains an archive on a disk storage unit 114. Client system 102 may browse this archive.

The configuration of network 100 is of course only representative. For example, automatic archiving of documents may be implemented with only one or two types of office machine instead of the depicted types. Also, functionality of one or more units shown in FIG. 1 may be combined into the same unit or divided among many units.

Automatic Archiving of Copied Documents

In accordance with the present invention, digital copier 106 transparently archives documents that are copied. FIG. 2 depicts a simplified representation of a portion of a copier control interface 200 usable with digital copier 106. Copier control interface 200 includes a numeric keypad 202, an Enter key 204, and a Copy/Start key 206. Copier control interface 200 may be implemented using, e.g., a touch pad, touch screen, mechanical buttons, etc. Controls for paper size, copy darkness, copy contrast, paper size, and magnification/reduction ratio are not important to the present invention and are thus omitted.

In accordance with one embodiment of the present invention, activation of Copy/Start key 206 is sufficient to initiate both copying of a document and archiving of an image of the document. The user positions the document, e.g., in a document feeder (not shown), and then enters a personal access code on numeric keypad 202. After finishing access code entry by depressing Enter key 204. Depressing Copy/Start key 206 represents a single user command that is interpreted by digital copier 106 to request both copying and archiving. Thus by copying, the user achieves both copying and archiving. In one embodiment, the user may enter a lock-out code to inhibit archiving, for instance, for privacy-protection purposes.

Details of the hardware for the copying and archiving processes will be made clearer with reference to FIGS. 3-5.

FIG. 3 depicts a top-level diagram of digital copier 106 implementing automatic document archiving in accordance with one embodiment of the present invention. Digital copier 106 includes a scanner engine 302, a print engine 304, a controller 306, a touch screen 308, and an internal disk storage unit 310. Controller 306 includes a DRAM unit 312, an LZ image compressor 314, a CPU 316, an IDE controller 318, a SCSI controller 320, and a network interface 321. A bus 323 interconnects the controller elements. Scanner engine 302 includes a scanner 302A and an image processing unit 302B. A video bus 324 interconnects scanner engine 302 and print engine 304. An image data tap 326 provides controller 306 with access to image data transferred over video bus 324. Controller 306 also takes advantage of an HSYNC signal 406 and a VSYNC signal 410 generated within print engine 304.

Digital copier 106 accepts a document 328 and prints a copy 330 upon depression of Start/Copy key 206. Scanner 302A captures an image of document 328 and transmits the image to image processing unit 302B. Image processing unit 302B operates to remove distortion inherent in the scanning process. The output of the image processing unit is preferably in a format where 8 bits represent the grey-scale level of a pixel, and there are 330 active lines per frame or document page. There is a 10 pixel blanking period before and after each active line, making the total number of pixels per line, 4400. Similarly, there is a 10 line blanking period before and after every frame, making the total number of lines in a frame 3400. Of course, these parameters are only design choices.

This pixel data is forwarded from image processing unit 302B to print engine 304 for printing. The data rate over video bus 324 is preferably 20 MHz. Controller 306 monitors video bus 324 via image data tap 326 to receive the same pixel data. Although, it would be possible to monitor the pixel data prior to image processing unit 302B, the advantage to monitoring on video bus 324 is that image processing unit 302B is tightly coupled to scanner 302A and can monitor and correct for errors inherent in the scanning process.

Controller 306 performs overall control functions for digital copier 106 including the archiving functions. CPU 316, an Intel 80960 CF microcontroller, operates the control program for the operation of digital copier 106. Image data is often transferred into controller 306 at a faster rate via image data tap 326 than the image data can be archived. Accordingly, DRAM unit 312, preferably incorporating 8 to 72 MB of DRAM, acts as a buffer for image data. This allows printing of the copy to continue without interruption by the archiving process.

To save on storage space and facilitate faster data transfer across network 100, LZ image compressor 314 may compress the image data prior to archiving in accordance with the Lempel-Ziv image compression format. Of course, any image compression format may be chosen in accordance with the invention. With each block of image data to be archived, controller 306 incorporates the user ID data received from touch screen 308.

The actual archiving of document images may occur either locally or remotely. Controller 306 may maintain the archive on disk storage unit 310, in which case the image data will be transferred via IDE controller 318. The archive may also be maintained either internally or externally on SCSI drives to which image data is transferred via SCSI controller 320. Note, that if the archive is maintained on disk storage unit 310, or a disk drive accessible via SCSI controller 320, digital copier 106 will absorb some or all of the functionality of document management workstation 108. If the archive is maintained on document management workstation 108, network interface 321 sends the image data there via network 100 along with the user ID data for each particular document. Typically, LZ image compressor 314 is used in applications where documents are archived locally as opposed to remotely.

FIG. 4 depicts signals transferred over video bus 324 and image data tap 326 in accordance with one embodiment of the present invention. A pixel data line 327 carries the image data generated by image processing unit 302B in a format to drive a laser diode input port 402 of print engine 304. Each pixel includes 8 bits, which represent the grey-scale level of a pixel, and there are 330 active lines per frame or document page. There is a 10 pixel blanking period before and after each active line, making the total number of pixels per line, 4400. Similarly, there is a 10 line blanking period before and after every frame, making the total number of lines in a frame 3400. Of course, these parameters are only design choices.

Print engine 304 operates in accordance with well-known laser xerography principles and incorporates a laser diode that varies in illumination intensity responsive to the document image to be printed. The 8 bits input to laser diode
input port 402 includes 3 bits modulating the intensity of illumination of the laser diode and 5 bits modulating the width of illumination pulses. These pixels transfer over a pixel data line 327 at a 20 MHz rate. In the preferred embodiment, the image data presented at laser diode input port 402 is directly relayed to controller 306 via image data tap 326.

The beam output of the laser diode passes through a system of lens and mirrors that generates the horizontal scanning action to sweep the beam over a rotating xerographic drum, thereby recreating the document image as a charge pattern on the drum. Typically, the rotation of a polygonal mirror tracks the scanning action. To assure the highest quality of reproduction, printing requires careful synchronization between the constituent parts of the scanner 302A, image processing unit 302B and the Print Engine 304. This synchronization is signalling using the horizontal and vertical video synchronization signals, lines 404, 406, 408, and 410. All of these signals are interrelated in terms of synchronization to the motion inherent in the rotating polygonal mirror which provides faster scanning in the print engine, and in terms of the scanner 302A. In some embodiments, the timing may be sourced by the print engine 304, and circuitry in image processing unit 302B is phase-locked to that timing. In an alternate embodiment, image processing unit 302B may provide the master timing to the print engine 304, which subsequently phase-locks or otherwise synchronizes its mechanical motion to these source signals. This embodiment is illustrated in FIG. 4. Those skilled in the art will recognize the various trade-offs in product design originating from alternative selections of the master reference timing sources used for generating the synchronization signals in the system of FIG. 4, without losing the generality of obtaining access to the video bus 324.

Horizontal synchronization signal (HSYNC) 406 for the image data may be obtained from print engine 304 in many ways. One technique is to position an optically sensitive sensor at a point within the optical system where the scanning action of the beam may be monitored. A pulse is generated every time the beam reaches an extremity of the scan. Depending on the particular design of the optical system, this pulse rate may be a harmonic or subharmonic of the actual horizontal synchronization rate.

Another technique is to attach an optical encoder to the motor that rotates the polygonal mirror. By monitoring the motor operation in this, or some other way, horizontal synchronization signal 406 may be derived. It is also possible to derive horizontal synchronization signal 406 from the control signal which drives the motor.

A vertical synchronization control 408 also incorporates information about the scanning action of scanner 302A. To assure high quality reproduction, the movement of paper through print engine 304 takes this vertical synchronization control information into account. Vertical synchronization signal 410 may be obtained from print engine 304 in a variety of ways. One way is to tap off an internal signal that gates a new sheet of paper to pass underneath the xerographic drum.

The horizontal and vertical synchronization signals 406 and 410 are used to assure that only valid pixels are archived. Data indicating the number of lines on each page and the line length in pixels is also archived with the pixels. Thus, when the document is retrieved for printing later, printing of the document inherently takes advantage of the information present on vertical synchronization control 408 and horizontal synchronization control 404, namely image position within a page, and more particularly, the size of paper printed upon. Furthermore, the document image has already been subject to sophisticated image processing by IPU 302B. The final printed document is therefore a very high quality reproduction.

The present invention is however not restricted to capturing image data for archiving at the output of an image processing system such as IPU 302B. Whether or not such an image processing system is present, image data for archiving may be captured at the output of scanner 302A.

Automatic Archiving of Printed Documents

FIG. 5 depicts a simplified representation of a user interface screen 500 for operating a printer. A user interface screen such as screen 500 is generally displayed by client system 102 whenever the user requests printing of a document. A list 502 of options permits the user to select whether the full document is to be printed, only a specified range of pages, or only text that has been highlighted using a pointing and selection device such as a mouse. If a range of pages is to be specified, a field 504 is used to enter the range of page numbers. A field 506 permits the user to specify a number of document copies to be printed. A “current printer” field 508 identifies the printer that will be used to print the document. Activation of a “Close” screen button 510 dismisses interface screen 500.

In the prior art, activation of a “Print” screen button 512 causes a document to be printed. In accordance with one embodiment of the present invention, activation of “Print” button 512 represents a single user command to both print and archive the document. Client system 102 sends the document to be printed to print server 104 which runs print spooling software for writing to printer 112. The print spooling software maintains a queue of print jobs to run. The document may be sent to print server 104 in any format, such as text, TIFF, GIF, postscript, etc. Printer 112 will typically accept postscript input but other printer configurations are also possible. If the format of transmission by client system 102 is different from the format accepted by printer 112, printer server 104 will also perform format conversion.

In accordance with the invention, each document handled by print spooling software is sent to document management workstation 108. The document may be transmitted in either the format generated by client system 102 or any format to which printer server 104 is able to convert. The document may be sent to document management workstation 108 with data identifying the current user of client system 102. Thus, archiving becomes an incidental consequence of the printing process. Previously printed documents are retrievable.

Automatic Archiving of Faxed Documents

FIG. 6 depicts a simplified representation of a facsimile machine user interface 600. A display screen 602 provides the user with prompts. A keypad 604 allows for entry of a telephone number to which a document is to be faxed. Depression of a start button 606 causes a document to be scanned into a memory within a facsimile machine or, if a document has already been scanned into memory and a telephone number has been entered, causes the document to be faxed to the entered telephone number. Depression of a stop button 608 causes faxing to cease. In accordance with the present invention, depression of start button 606 at the appropriate time represents a single user command to both fax and archive a document.

FIG. 7 depicts facsimile machine 110 modified for automatic archiving in accordance with one embodiment of the
without further user input. This provides yet another source workstation player 836 receives a computer system 836, and a floppy-disk drive 838. A mouse 838 receives a floppy disk 846. Many other devices or serial port 828, keyboard (not shown) internal to scanner module for scanning a document to be faxed and storing the fixed disk drive 114 via a data tapped CD-ROM player 834, a CD-ROM floppy disk drive 844. Floppy-disk drive 838 receives a floppy disk 846. Many other devices or subsystems (not shown) may be connected in a similar manner. Also, it is not necessary for all of the devices shown in FIG. 8 to be present to practice the present invention, as discussed below. The devices and subsystems may be interconnected in different ways from that shown in FIG. 8.

FIG. 9 depicts a software architecture 900 for operating a document image database in accordance with one embodiment of the present invention. Preferably, the software architecture operates on document management workstation 108. Documents to be archived are received by a CFI module 906 to perform functions such as searching or display and printing of particular document formats.

Of course, the storage and retrieval architecture discussed above is only representative. The co-filed application “DOCUMENT MANAGEMENT SYSTEM” includes many other applications of an automatic archiving system. In the foregoing specification, the invention has been described with reference to specific exemplary embodiments thereof. It will, however, be evident that various modifications and changes may be made thereunto without departing from the broader spirit and scope of the invention as set forth in the appended claims. Many such changes or modifications will be readily apparent to one of ordinary skill in the art. For example, digital copier 106 may also act as a printer for
What is claimed is:

1. A method of providing unconscious archiving of documents in an automated office environment comprising a network coupled to at least one input device configured to perform a first function, the first function exclusive of a storage function, and at least one document management workstation having at least one database disposed to receive electronic copies of the documents for archiving, the method comprising:

   receiving a single user input via the at least one input device to perform the first function, the single user input specifying a first function a user wants to perform on a document, and

   in response to receiving the single user input, automatically:

   scanning the document using the one input device to generate electronic document image data corresponding to the document;

   after scanning the document, performing the first function using the at least one input device, wherein the first function is performed by a first subsystem of the at least one input device;

   after performing the first function, communicating the electronic document image data to the at least one database using a second subsystem of the at least one input device, wherein the first subsystem is separate from the second subsystem; and

   archiving the document by storing the electronic document image data in the at least one database.

2. The method of claim 1 further comprising archiving an icon and at least one of a plurality of keywords descriptive of the document.

3. The method of claim 1 further comprising providing access to the document archived in the at least one database.

4. The method of claim 3 wherein the document is provided in HTML format, and the access to the document is provided using a browser.

5. The method of claim 1 wherein the network further comprises the Internet.

6. The method of claim 1 further comprising storing information related to lines in the document along with the electronic document image data in the at least one database.

7. The method of claim 1 wherein the at least one input device comprises a scanner.

8. The method of claim 1 wherein the at least one input device comprises a digital copier and performing the first function comprises generating a copy of the document.

9. The method of claim 1 further comprising retrieving the electronic document image data for the document from the database; and

   converting the electronic document image data into a textual format.

10. The method of claim 1 further comprising:

    receiving a user identifier identifying a user providing the single user input; and

    in response to receiving the single user input, automatically storing the user identifier along with the electronic document image data in the at least one database.

11. The method of claim 10 further comprising controlling access to the network based upon the user identifier.

12. The method of claim 10 further comprising indexing the archived documents in the at least one database using the user identifiers stored along with the electronic document image data stored for the documents.

13. The method of claim 1 wherein the at least one input device comprises a printer and performing the first function comprises printing the document.

14. The method of claim 1 wherein the at least one input device comprises a facsimile machine and performing the first function comprises faxesing the document.

15. A system for performing unconscious archiving of documents, the system comprising:

    a device configured to perform a first function, wherein the first function is exclusive of a storage function;

    a computer having a storage medium; and

    a network interconnecting the computer with the device; wherein the device is configured to receive a single user input, the single user input specifying a first function that a user wants to perform on a document to perform the first function, and in response to receiving the single user input the device is configured to automatically:

    scan the document to generate image data for the document;

    perform the first function using a first subsystem of the device; and

    communicate the image data for the document to the computer using a second subsystem of the device after performance of the first function, wherein the second subsystem is separate from the first subsystem, and

    wherein the computer is configured to store the image data received from the device in the storage medium.

16. The system of claim 15 wherein the device is configured to receive a user identifier, the user identifier identifying a user providing the single input; and

    wherein access to the network is controlled based upon the identifier.

17. The system of claim 16 wherein the computer is configured to index the stored image data for the document using the user identifier.

18. The system of claim 15 wherein the computer is configured to archive an icon and at least one of a plurality of keywords descriptive of the document in the storage medium.

19. The system of claim 15 wherein the document archived in the storage medium is accessible for viewing.

20. The system of claim 19 wherein the document is provided in HTML format and is accessible using a browser.

21. The system of claim 15 wherein the network further comprises the Internet.

22. The system of claim 15 wherein information related to lines in the document is stored along with the image data for the document in the storage medium.

23. The system of claim 15 wherein the device comprises a scanner.

24. The system of claim 15 wherein the image data for the document stored in the storage medium is retrieved from the storage medium and converted into a textual format.

25. The system of claim 15 wherein the device comprises a copier and the first function comprises generating a copy of the document.

26. The system of claim 15 wherein the device comprises a printer and the first function comprises printing a copy of the document.

27. The system of claim 15 wherein the device comprises a fax machine and the first function comprises faxesing a copy of the document.
28. A computer program product stored on a computer readable storage medium for providing unconscious archiving of documents in a network environment comprising a network coupled to at least one input device configured to perform a first function, the first function exclusive of a storage function, and at least one document management workstation having at least one database disposed to receive electronic copies of the documents for archiving, the computer program product comprising:

- code for receiving a single user input via the at least one input device to perform the first function, the single user input specifying a first function a user wants to perform on a document;
- in response to receiving the single user input, code for automatically:
  - scanning a the document using the at least one input device to generate an electronic document image data of the document;
  - after scanning the document performing the first function using a first subsystem of the at least one input device;
- after performing the first function, communicating the electronic document image data to the at least one database using a second subsystem of the at least one input device, wherein the second subsystem is separate from the first subsystem; and
- archiving the document by storing the electronic document image data in the at least one database.

29. The computer program product of claim 28 further comprising code for archiving an icon and at least one of a plurality of keywords descriptive of the document.

30. The computer program product of claim 28 further comprising code for providing access to the electronic document image data archived in the at least one database.

31. The computer program product of claim 28 wherein the access to the electronic document image data is provided using a browser.

32. The computer program product of claim 28 wherein the network further comprises the Internet.

33. The computer program product of claim 28 further comprising code for indexing documents archived in the at least one database based upon the user identifiers stored along with the electronic document image data for the documents.

34. The computer program product of claim 28 wherein the at least one input device comprises a printer and the code for performing the first function comprises code for printing a copy of the document.

35. The computer program product of claim 28 wherein the at least one input device comprises a copier and the code for performing the first function comprises code generating a copy of the document.

36. The computer program product of claim 28 further comprising code for receiving a user identifier identifying a user providing the single user input; and

- in response to receiving the single user input, code for automatically storing the user identifier along with the electronic document image data in the at least one database.

37. The computer program product of claim 36 further comprising code for controlling access to the network based upon said the user identifier.