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Samari

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(54) **MEDICAL DATA RECORDING SYSTEM**

(76) Inventor: **Cyrus Kurosh Samari**, Burnsville, MN (US)

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G06F 3/12 (2006.01)

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See application file for complete search history.

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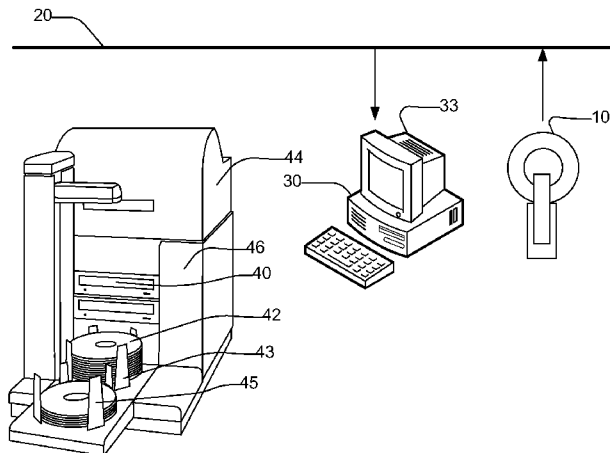
Primary Examiner — Dov Popovici

(74) *Attorney, Agent, or Firm* — Clise, Billion & Cyr, P.A.; Richard Billion

(57) **ABSTRACT**

A medical data recording method includes receiving medical data information in DICOM format through a software module and parsing patient identification information and study information from the received medical data information. The parsed patient identification information and parsed study information is stored. Print information for an autoloader control software has selected fields obtained from the stored parsed patient identification information and the stored parsed study information. DICOM images and other files are recorded on a recording media. The label is automatically printed using selected fields from the stored parsed patient identification information and the stored parsed study information on the recording media to label the recording media.

19 Claims, 4 Drawing Sheets



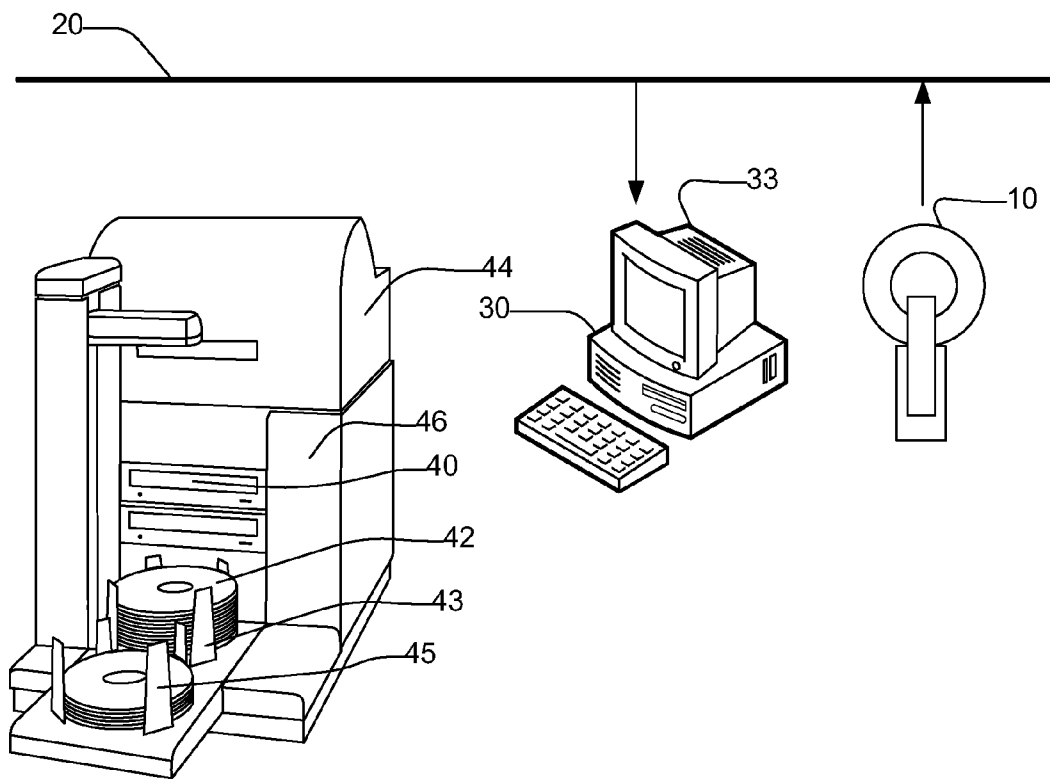


Figure 1

Figure 2.

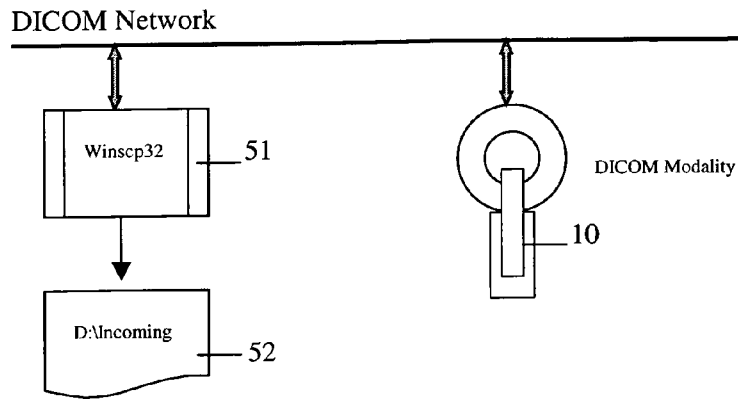


Figure 3.

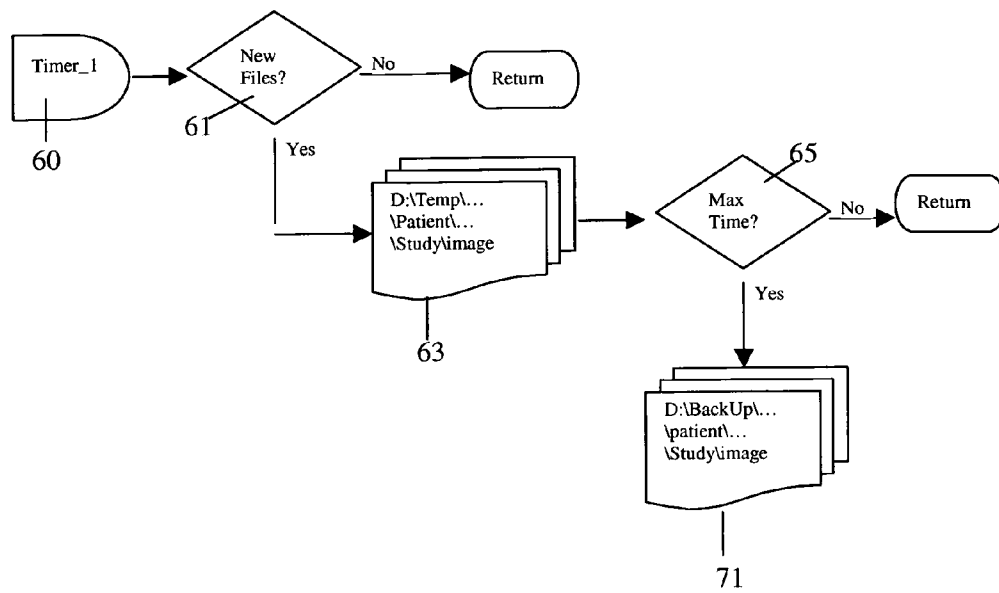


Figure 4

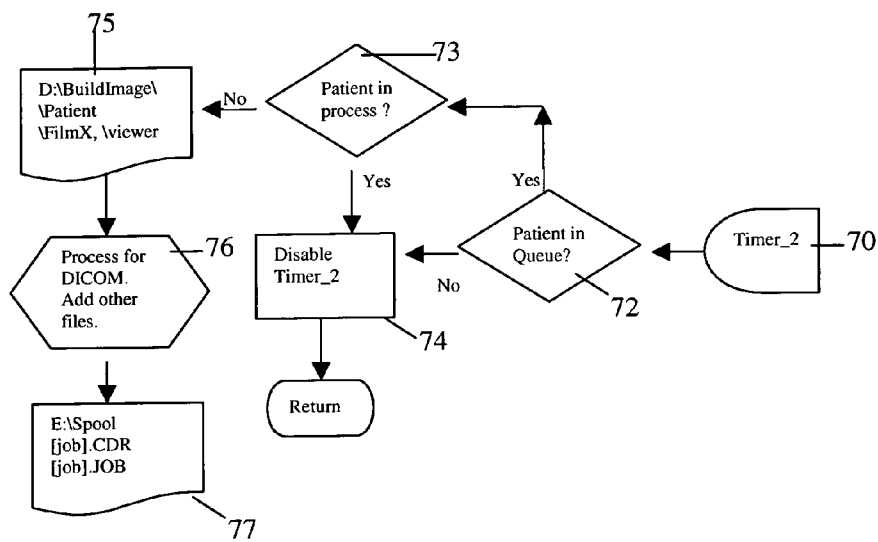


Figure 5.

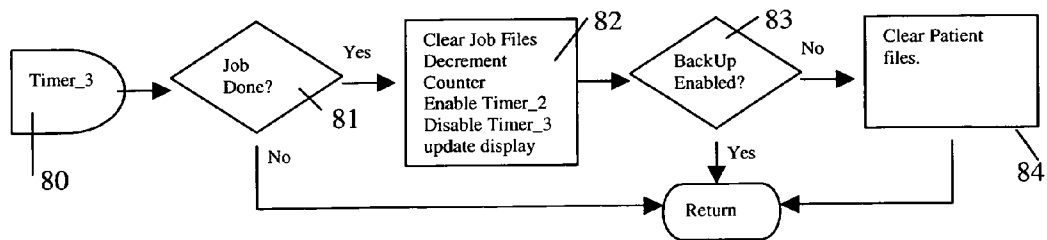
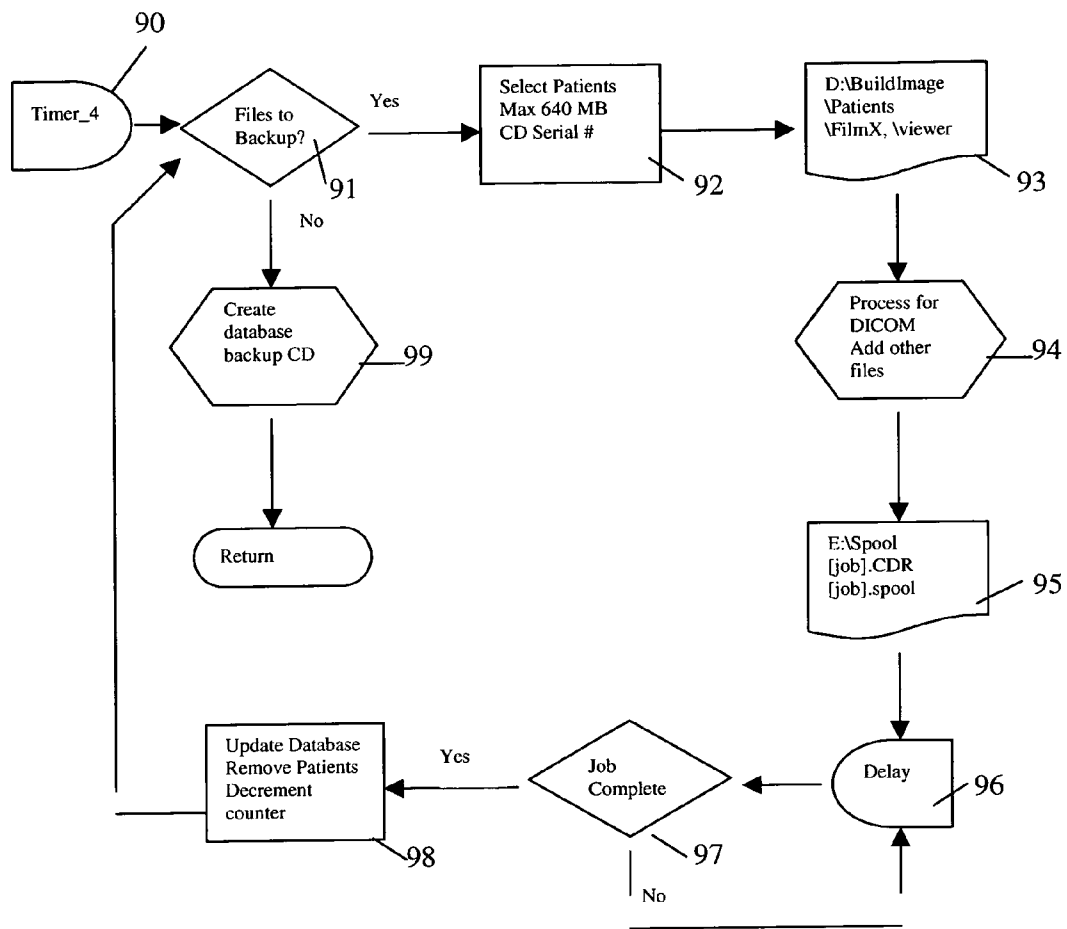


Figure 6.



MEDICAL DATA RECORDING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to data storage and more particularly to determining end of incoming data stream in order to create jobs for recording and printing file information on a disc taken from the electronically stored information on the disc.

2. Description of the Related Art

In the past medical imaging such as x-rays were recorded on film and digital images were stored on digital film using film laser printers, which is expensive, bulky and difficult to store. Also, the original digital data might have to be modified so it can be printed using a laser printer since most printers can not handle high resolution or high quality digital data. Digital image storage allows storage and retrieval of original digital data on discs and transmittal of images over communications systems such as the internet.

There are printers combined with CD recording devices for printing on the disc that has just been recorded.

Medical imaging data is frequently manually stored on CD's and filed for later use in doctor's offices, hospitals, clinics and other medical facilities. The medical images may be generated by x-rays, cat scans, magnetic resonance images, sonograms or other image generating technologies.

Medical imaging data can be transmitted from one location to another over the internet or other communication system for recording the data. The filing and record keeping of the images thus received is a problem. It is a labor-intensive and error-prone task to gather information about each disc, write out labels and attach the labels to the discs, or write directly on the disc for storing and filing. It is very useful to have the information contained on a disc printed on the disc for reference and filing and for automatically creating a directory of the information stored on all the discs recorded in an office.

SUMMARY OF THE INVENTION

The present invention automatically scans data received for storage on the disc and prints selected fields of information directly on the discs for ease of file management. The invention also constantly updates a database having a directory of all patient records and the discs the patient data is stored on. Although the invention is described in terms of storing medical imaging data any data imbedded with information useful for filing and label printing can be used with the invention.

The Medical Data Recording System hardware consists of three main components: a computer server; a CD autoloader with printer; and a piracy prevention device. The software components are: DICOM® communication software; FilmX™ software for storing software for viewing the images on the CDs, software for selecting image information to be copied to the CD and fields for printing on the discs; software for creating and updating a database of patient information and autoloader control software for the CDR and printer; and security device driver software.

The computer server communicates with other medical devices on the network using the DICOM® protocol. It receives medical images (patient studies) from other devices, processes the images and burns each patient's images on one or more CDRs along with medical image viewing software and other files as defined by the DICOM® protocol as well as files containing printed label definition and graphics files, files containing patient and study demographics, and necessary system files to make the CD autorun and autoloader. Once a CDR has been burnt, information regarding the contents of

the CDR and other graphics (company logo, legal notices, etc) is then printed directly on the CDR using the printer attached to the autoloader. Optionally, the system will create back up copies of the medical images it has received by burning them on CDR at configured days of the week and time. Each back up CDR will contain as many patients' images as possible to maximize disc space usage. Each backup disc is assigned a serial number which is printed on it. The patient and study demographics of the backed up data along with the corresponding backup disc serial number is stored in a database where they can be queried.

OBJECTS OF THE INVENTION

It is an object of the invention to print information from selected fields of data saved on a disc onto the disc for visual recognition such that the discs can be properly stored in files.

It is an object of the invention to reduce clerical time and reduce errors by having discs printed with information fields from files stored on the discs.

It is an object of the invention to automatically load discs for information storage.

It is an object of the invention to automatically stop recording when the information stream has stopped and load a new disc for the next patient.

It is an object of the invention to print trademarks, service marks and logos on the discs.

It is an object of the invention to print selectable fields of information on the discs.

It is an object of the invention to back up files at specified time intervals.

It is an object of the invention to get as many images as possible onto one CDR.

It is an object of the invention to conveniently store medical image data on CD's rather than on film.

It is an object of the invention to be able to use a computer display to view medical images stored on CD's.

It is an object of the invention to preserve medical images for long periods of time.

It is an object of the invention to create patient files with directories and subdirectories from image data streams.

It is an object of the invention to divide data streams into separate files.

It is an object of the invention to automatically create and update file databases to locate patient information on the discs.

Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic of the system using the data recording system.

FIG. 2 shows a block diagram of the software steps used in the computer for receiving files from the network and storing them on the computer.

FIG. 3 shows the routine for determining the data for jobs from incoming files.

FIG. 4 shows the routine for processing jobs in queue.

FIG. 5 shows the routine for checking for end of jobs.

FIG. 6 shows the routine for the backup process.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a schematic view of the invention. A medical imaging device 10 such as an x-ray, cat scan, magnetic reso-

nance imaging, sonogram or other device which generates information for storage on a disc generates images of a patient and either transmits it or stores it for later transmittal through a communication network 20 such as the internet to a computer 30. The computer 30 can be used to select information to be stored by the compact disc writer 40 on compact discs, CDs, 42 and can select what information is to be printed by printer 44 on discs 42. Although CDs 42 are shown, any recording medium may be used for storage of information. The blank compact discs 42 are stacked in an input CD stack 43 waiting to be recorded. The CD autoloader 46 selects CDs 42 from the top of the input CD stack 43 to be recorded on and places the CDs 42 into the recorder 40. When the CD 42 has information stored on it, it is moved by the CD autoloader 46 to the printer 44 where selected information and logos or other graphics are printed on the CD 42 so that the users have a written record on the disc of the information stored thereon and logos identifying the producer of the disc or other information. The CDs 42 are then removed from the printer 44 by CD autoloader 46 and placed in the CD output tray 45. The CDs 42 can then be placed in patient files.

The software for running the invention performs several tasks. There is security software communicating to an attached piracy prevention security device that keeps track of how many CDs are being recorded and what product option are active. There is software to run the autoloading functions of the CD autoloader 46 for recording and moving discs 42. The software also can be programmed to select the fields of information to be printed on the discs and for printing logos or other graphics or information on the discs. The software also copies instructions for operating the imaging onto the disc so that a computer without imaging software loaded in it can view the images on the discs.

Although many different software programs can be used to accomplish the goals set out above the following shows one method of securing image information for later viewing and recording it on discs with labels printed thereon. The software described herein is called FilmX™ software by the applicant.

FilmX™ software is used to receive data in the computer 30 from the communication network 20. The software incorporates DICOM® network connectivity software 51 such as WinSCP32.exe which is currently a standard digital imaging protocol used in the industry to receive the digital imaging data from the imaging device 10. The imaging data is received in the computer 30 by use of network connectivity software 51 using “winSCP32.exe” software available from ETIAM Corporation; Rennes, France. This program is a Storage Service Class Provider using the DICOM® protocol. The computer 30 receives DICOM images that are sent to it and places them in the Incoming (“D:\Incoming”) directory 52. The files are named: <Storage SOP Class>.<SOP Instance UID>.dcm where <Storage SOP Class> is the SOP class of the image and <SOP Instance UID> is the image UID (Unique Identifier).

There are multiple timers defined with in FilmX.exe. Timer_1 60 is responsible for checking for incoming new files 61 in Incoming Directory 52. If new files are received they are stored as a separate file in a temporary directory Temp Directory 63. Timer_1 60 is programmed to check if an end-of-patient-data timeout (MaxTime) 65 has occurred. The value for Timer_1 60 is defined in the FilmX.ini file and is hence user configurable. Default time for Timer_1 60 is 1 (one) second. Max Time 65 is also user configurable via FilmX.ini and is set to 30 seconds for default. The system will not allow that time to be set less than 10 seconds. Once the Timer_1 60 goes off, two routines are called:
DcmBTreeParseInputDirectory
dcmBTreeMakePatientDataAvailable

The first routine parses any DICOM Part 10 file found in Incoming Directory 52. If any new files 61 are available, they are transferred to the Temp Directory (d:\Temp) 63. For each different patient, a subdirectory is created under the Temp Directory 63, and for each study of this patient, a subdirectory is created under the patient directory.

Patient differentiation is based on Patient Identification which consists of the concatenation of information found in DICOM datasets: PatientsID ‘_’ PatientsName, without any ‘^’, any white character or any character that may lead to an invalid Windows directory name, all characters are upper-case and enclosing blanks are removed. Patient Directory name underneath Temp Directory 63 is the Patient Identification described above.

Study identification is based on the StudyInstanceUID. Study Directory name beneath the Patient Directory is the study identification referenced above.

Filenames are the original filenames found in Incoming Directory 52. This allows the system to override an image if it is sent twice.

An additional text file is created in each Patient Directory. This file has a fixed name (timestamp.bsy) and contains the date and time of the last image insertion in the Patient hierarchy. The following information is also written in this file:

PatientsName
PatientsSex
PatientsBirthDate

An additional text file is created in each Study Directory. This file has a fixed name (study.dsc) and contains the information extracted from the last image of the study inserted in the Study Directory. This information is as follows:

StudyDate
StudyTime
StudyID
StudyDescription
ReferringPhysiciansName
AccessionNumber.

Once DcmBTreeParseInputDirectory has returned, any new patients are added to the Incoming Patient Queue and displayed on the screen as such. The combination of patient “[id]_[name]” is now the internal job name used for tracking the job.

Then dcmBTreeMakePatientDataAvailable is called to check in Temp Directory 63 if any patient subdirectories have not been modified (some images added) since MaxTime 65 seconds ago. The number of unmodified directories since MaxTime 65 seconds is returned. If no new files 61 have arrived for a patient, the timestamp file (timestamp.bsy) for the patient will be renamed to a fixed filename (timestamp.rdy).

Once the function returns a positive number, we browse for Patient Directories in the Temp Directory 63 containing “timestamp.rdy” file. The entire patient hierarchy is then moved to the Backup Directory 71 (D:\Backup). The Job is then removed from the Incoming Patient Queue and added to the Pending Patient Queue and displayed as such. If inactive, Timer_2 70 is activated to start processing the pending job(s).

Timer_2 70 is responsible for moving jobs pending in Queue to be processed. Once it goes off, the system is checked for any patient in queue 72, if none are present, Timer_2 70 is disabled in step 74. If there are pending jobs in Pending Patient Queue, the system is checked for patient in process 73 (being recorded or printed). If there is one, Timer_2 70 is disabled and it returns. If there are no patients in process 73, the next job in Pending Patient Queue, is processed. The patient directory hierarchy in Backup Directory 71 is moved

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to the Build Image Directory **75** (D:\Build Image) to get ready to burn on CDR(s). The Build Image Directory **75** also contains a Viewer Directory (“Viewer”) where the viewing software resides. There is also a FilmX Directory (“FilmX”) in the Build Image Directory **75** which contains the Patient information file (“Patient.txt”) and the Xlabel Directory (“Xlabel”) where the CD printing label definitions and graphics files reside. Since DICOM Exchange standards only allow for eight character file names, the Patient, and Study directories as well as image file names are converted to eight character format in processing step **76**. The Patient Directory name is changed to “PT000000” for the first patient. In case of back up CD, Patient Directories are then sequentially named “PT000001” and so on. The Study Directory(ies) are named starting with “ST000000” and increase sequentially if there is more than one study for the patient. The image files are then named starting with “IM000000” and so on. On the Build Image Directory **75** there is also an “autorun” file which is recognized by the Windows operating system and executed when a disc is inserted in a computer. The “autorun” file contains instructions to start the viewer in an “autoload” fashion causing it to immediately load and display the first Patient’s first Study. Finally, according to DICOM Exchange standard, a “DICOMDIR” file is generated in step **76** in the Build Image Directory **75**.

Once the Build Image Directory **75** is complete, it represents what should be put on the final CDR with Build Image Directory **75** as the root of the CD. The computer program “Premaster.exe” is then called to create a CD image of the contents of the Build Image Directory **75**. This program is part of the BuzzSaw® software package produced by ISO Media of Seattle, Wash. The result is a “[job].CDR” file which is the image of the final CDR. It is located in the Spool Directory **77** (E:\Spool). A “[job]job” file containing the job control information for the autoloader control software (Buzzsaw®) is created in the Spool Directory **77**. The Job file specifies the name of the CDR file, the input file for the print label fields, the number of CDRs to be made, the test flag, and other fields as required by the Buzzsaw® software. Once the CD image files is generated in the Spool Directory **77**, the Build Image Directory **75** is then cleared of the patient directory and other created files. Once created, the job file is recognized by the Buzzsaw software and processed.

Buzzsaw® instructs the autoloader **46** to pick up a new CDR **42**, put it in the CDR drive **40**. Once there, Buzzsaw® will proceed to record the contents of “[job].CDR” file on the CDR **42** in the drive **40**. In multi-copy, multi-drive situations, Buzzsaw® will place new CDRs **42** in other drives **40** as well and record them simultaneously. Once the recording is finished, Buzzsaw instructs the autoloader **46** to place the recorded CDR **42** in the Disc Printer **44**. It will then execute the printing software to print the label containing the input fields on the CDR.

The label printing software and printer driver are supplied by Primera Technologies; Plymouth, Minn., a disc printer manufacturer. The label definitions allow for input fields to be merged into the label via a merge file in Build Image Directory **75**. The patient.txt file in the Build Image directory **75** is that merge file.

Once printed, the CDR **42** is then placed in the output bin **45** by the autoloader **46**. If there are multiple copies, the other CDRs **42** are then printed by the Disc Printer **44** and put on the output bin **45** as well by the autoloader **46**. Buzzsaw then updates the status line at the bottom of the “[job].JOB” file contained in the Spool Directory **77** to indicate the job is completed.

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Timer_3 **80** is responsible for checking the end of the job. Once Timer_3 **80** goes off, the system checks for job done **81**. If so, the job is moved from the Patients in Process to Patients completed and display is updated in step **82** where Timer_3 **80** is cleared, and Timer_2 **70** is enabled. If Backup Enabled **83** is false, the patient directory is deleted from Backup Directory **71**. Otherwise, it will be kept there to be used during the backup.

Timer_4 **90** starts the backup process. It is programmed to go off at the configured time on the configured day(s) of the week. The program then checks if there are any files to backup **91**. This is also a check for the end of back up process. If finished (or nothing left to back up), a CDR **42** containing only the latest database files is generated **99**. This is the backup disc for the database files. If there are files to backup **91**, in Select Patients step **92** enough patients are selected to fill a 650 MB CD (if there are enough) minus approximately 10 MB which is used for storing system, label, and viewer files. A Backup CD unique serial number is also generated in Select Patients step **92**. The patient directories are then moved from Backup Directory **71** to Build Image Directory **75**. The same processing as for a patient CD, as described in steps **75-77** above then occur steps **93-95**. Once a backup job is created, the software then goes through a timed delay **96** waiting for the job to finish by checking for job complete **97**. Once done, the database is updated with the patient and study information of all the patients on that CD and the CD unique serial number in Update Database step **98**. The process starts anew by checking to see if there are any more files to back up **91**.

A simple query screen allows for querying the backup database using patient name, patient id, or study date thus allowing the user to find which CD a patient information is stored on.

The piracy protection device is attached to the parallel port. It is initialized with the number of CDRs **42** purchased, and with patient and/or backup options. FilmX will create patient CDs if that option is enabled; back up CDs if that option is enabled; and both if both options are present. Once a job has been successfully completed, the number of CDs created by it are deducted from the counter in the piracy protection device. If at Zero, the system halts operation until a new code for additional CDs has been entered. Patient and/or backup options can be enabled by operator entering a code provided by Soma Corporation.

Even though the invention has been described herein using CDRs, other printable recording medium, including but not limited to CDR, CDRW, DVD-R, DVD-RW, DVD-RAM; can be used.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A medical data recording method comprising:
 - receiving medical data information in DICOM format through a software module and parsing patient identification information and study information from the received medical data information, the medical data further comprising one or more files,
 - storing the parsed patient identification information and parsed study information, the stored parsed study information and patient information coming from the one or more files,
 - storing DICOM image information coming from the one or more files,

noting the end of the received medical data information through the software module for each patient, creating a job containing medical data for a patient, and medical data image viewing software, and providing print information for an autoloader control software, the print information having selected fields obtained from an automatic scan of the stored parsed patient identification information and the stored parsed study information, submitting the job to the autoloader control software, and recording said DICOM image information from the one or more files on a recording media, recording other files as defined by DICOM on the recording media, recording on said recording media in response to the job, the medical data image viewing software and the medical data and automatically printing the selected fields of the automatic scan of the stored parsed patient identification information and the stored parsed study information on the recording media to label the recording media.

2. A medical data recording method as in claim 1, wherein the autoloader control software includes instructions for moving the recording media from a recording position to a print position in response to a software instruction; and moving the recording media to an output bin in response to a software instruction.

3. A medical data recording method as in claim 1 further comprising, backing up the medical data information on another recording media.

4. A medical data recording method as in claim 1 further comprising, storing the job after the job has been created.

5. A medical data recording method as in claim 4 further comprising, deleting the job after submitting the job to the autoloader control software.

6. A medical data recording method as in claim 1 wherein creating the job comprises utilizing a print file that includes a print template and print merge data.

7. A medical data recording method as in claim 1 wherein noting the end of the received medical data for a patient comprises utilizing a time out period.

8. A medical data recording method as in claim 1 wherein recording on the recording media comprises utilizing a CD-R.

9. A medical data recording method as in claim 1 wherein recording on the recording media comprises utilizing a disc having a format selected from a group consisting of: CD-R, CD-RW, DVD-R, DVD-RW, and DVD-RAM.

10. A medical data recording method as in claim 1 wherein the recording media is loaded, moved, and recorded automatically.

11. A medical data recording method as in claim 1 wherein the automatically printing includes printing a template includes using the automatic scan, the stored parsed patient identification information and the stored parsed study information from the print information.

12. A medical data recording method as in claim 1 further comprising automatically deleting patient information upon job completion.

13. A medical data recording method as in claim 1 further comprising automatically keeping patient information when backup is enabled.

14. A medical data recording method comprising: receiving medical data information in DICOM format through a software module communicatively coupled to a network, and extracting patient identification information and extracting study information from the received medical data information, storing DICOM image information coming from the medical data information, storing the extracted patient identification information and extracted study information, from the medical data information; automatically scanning the stored extracted patient identification information and the stored extracted study information for selected fields from one or more files, noting the end of the received medical data information through the software module for each patient, creating a job for a patient containing medical data, and medical data image viewing software, and providing print information for an autoloader control software, the print information having the selected fields obtained from the automatically scanning of the stored extracted patient identification information and the stored extracted study information, submitting the job to the autoloader control software, and recording at least one DICOM image on a disc, recording other files as defined by DICOM on the disc, recording on the disc the job such that the medical data image viewing software is recorded on the disc along with the medical data, and automatically printing the selected fields of the stored extracted patient identification information and the stored extracted study information, the selected fields used to label the disc.

15. The medical data recording method as in claim 14 wherein the disc is loaded, and moved automatically.

16. The medical data recording method as in claim 14 wherein the label for the disc includes selected logos, trademarks or images.

17. The medical data recording method as in claim 14 wherein the receiving medical data information includes receiving a plurality of files at different times.

18. The medical data recording method as in claim 14 wherein the noting the end of the received medical data comprises utilizing a time out period.

19. The medical data recording method as in claim 14 wherein the receiving medical data information includes receiving a plurality of patient files for different patients at different times.

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