

EXHIBIT C



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Brown

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(54) **NETWORKED SYSTEM FOR INTERACTIVE COMMUNICATION AND REMOTE MONITORING OF INDIVIDUALS**

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See application file for complete search history.

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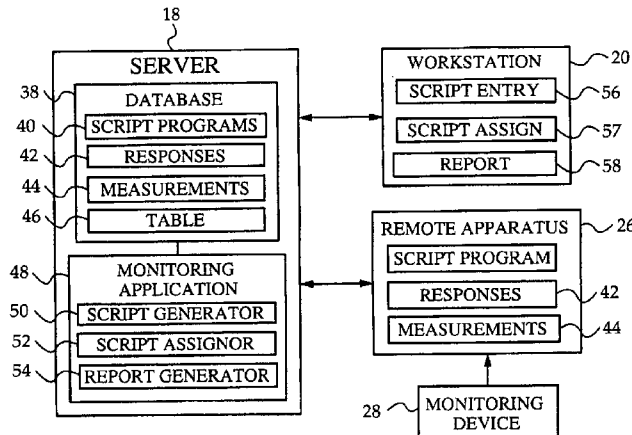
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(57) **ABSTRACT**

A system for remotely monitoring an individual. The system includes a server system for generating a script program from a set of queries. The script program is executable by a remote apparatus that displays information and/or a set of queries to the individual through a user interface. Responses to the queries that are entered through the user interface together with individual identification information are sent from the remote apparatus to the server system across a communication network. The server system also includes an automated answering service for providing a series of questions from a stored set of questions for an individual at the remote apparatus to respond to, storing responses to each provided question in the series of questions and providing a service based on the individual's response to the questions.

39 Claims, 20 Drawing Sheets



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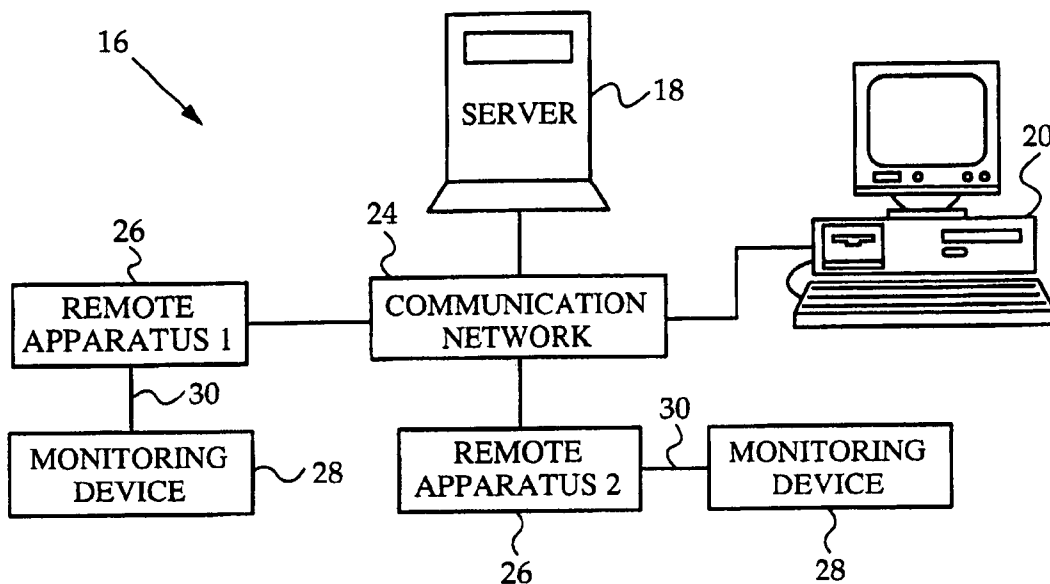


FIG. 1

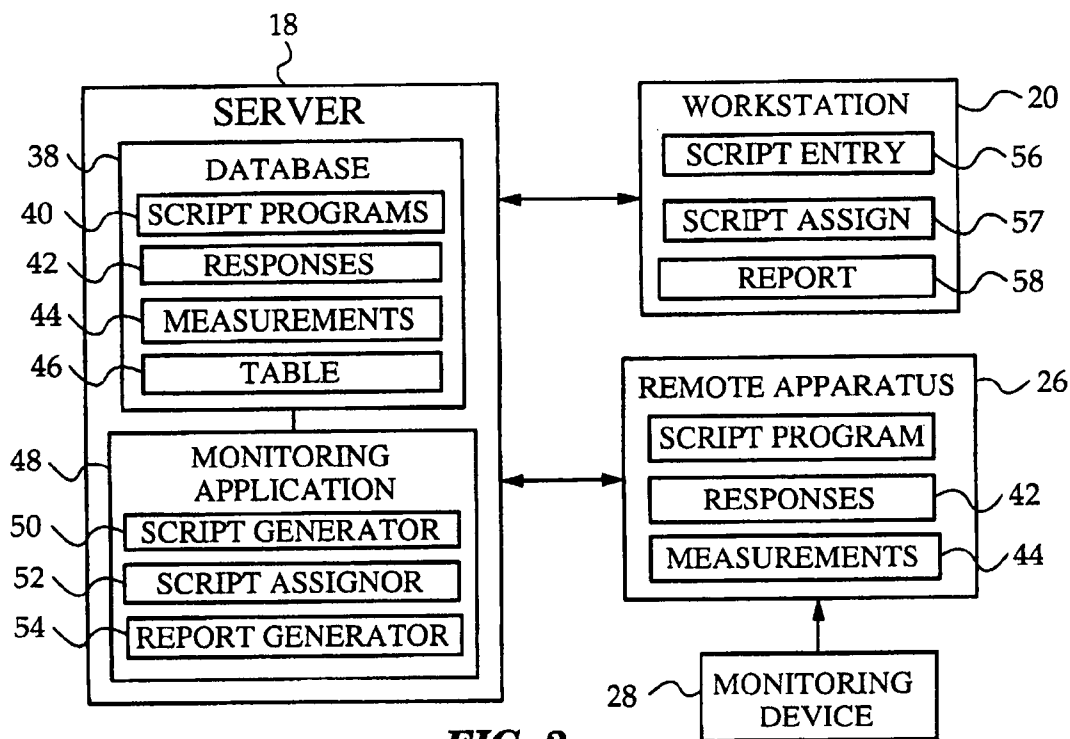


FIG. 2

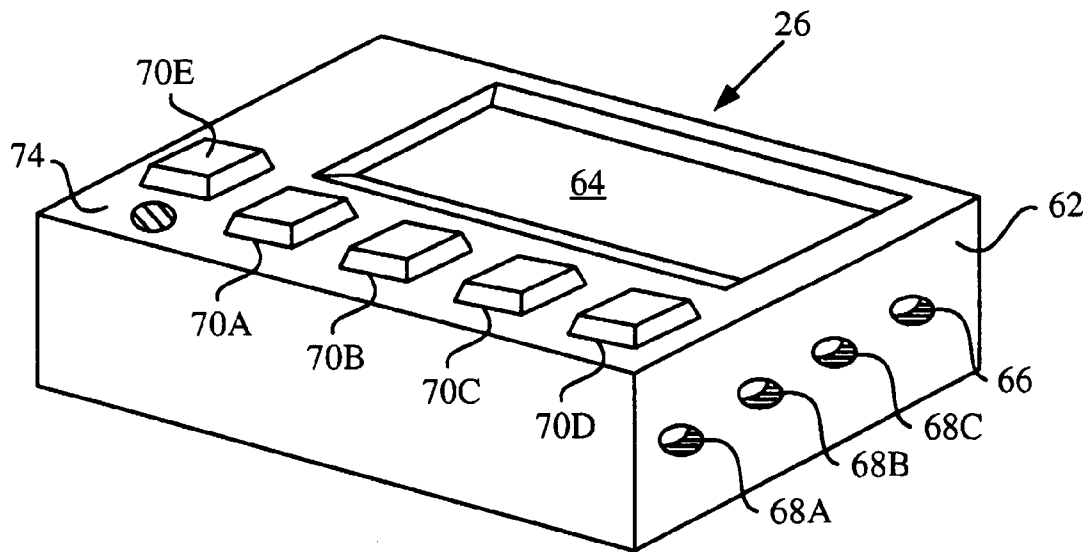


FIG. 3

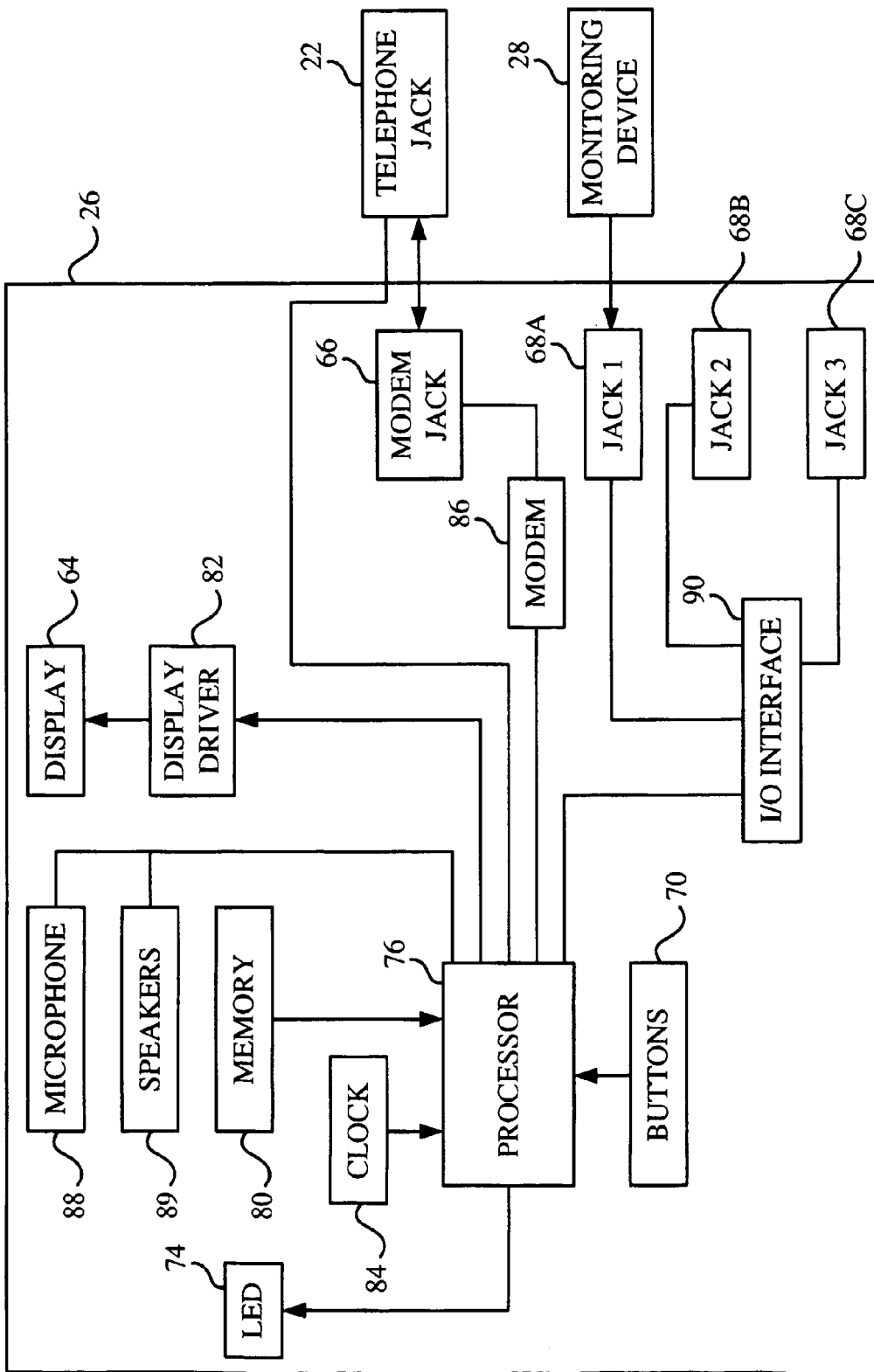


FIG. 4

56

SCRIPT ENTRY SCREEN

SCRIPT NAME: 92

QUERIES

	CHOICE 1	CHOICE 2	CHOICE 3	CHOICE 4
HOW DO YOU FEEL?	VERY BAD	BAD	GOOD	VERY GOOD
HOW WELL ARE YOU MANAGING YOUR DISEASE?	VERY BADLY	BADLY	WELL	VERY WELL
HOW HARD IS IT FOR YOU TO FOLLOW YOUR TREATMENT PLAN?	VERY HARD	HARD	EASY	VERY EASY
HOW HARD IS IT FOR YOU TO CONTROL YOUR BLOOD SUGAR?	VERY HARD	HARD	EASY	VERY EASY

94

SELECT DEVICE TYPE(S)

98 GLUCOSE METER RESPIRATORY FLOW METER BP CUFF

CONNECTION TIME: 100 102 104

FIG. 5

40

NUMBER: 9001 {LF}
 LED: 1 {LF}
 ZAP: {LF}
 CLS: {LF}

93 { DISPLAY: ANSWER QUERIES NOW?
 PRESS ANY BUTTON TO STATE {LF}
 WAIT: {LF}
 CLS: {LF}
 DISPLAY: HOW DO YOU FEEL?
 VERY VERY
 BAD BAD GOOD GOOD {LF}

95 { INPUT: OOOO {LF}
 CLS: {LF}
 DISPLAY: HOW WELL ARE YOU
 MANAGING YOUR DISEASE?
 VERY VERY
 WELL BADLY WELL WELL {LF}

INPUT: OOOO {LF}
 CLS: {LF}
 DISPLAY: HOW HARD IS IT FOR YOU TO
 FOLLOW YOUR TREATMENT PLAN?
 VERY VERY
 HARD HARD EASY EASY {LF}

INPUT: OOOO {LF}
 CLS: {LF}
 DISPLAY: HOW HARD IS IT FOR YOU TO
 CONTROL YOUR BLOOD SUGAR?
 VERY VERY
 HARD HARD EASY EASY {LF}

FIG. 6A


INPUT: OOOO {LF}
CLS: {LF}
DISPLAY: CONNECT GLUCOSE METER
AND PRESS ANY BUTTON
WHEN FINISHED {LF}
WAIT: {LF}
CLS: {LF}
DISPLAY: COLLECTING MEASUREMENTS {LF}
97  COLLECT: GLUCOSE_METER {LF}
CLS: {LF}
DISPLAY: CONNECT APPARATUS TO
TELEPHONE JACK AND PRESS ANY
BUTTON WHEN FINISHED {LF}
WAIT: {LF}
LED: 0 {LF}
CLS: {LF}
DELAY: 03:00 {LF}
DISPLAY: CONNECTING TO SERVER {LF}
CONNECT: {LF}
{EOF}

FIG. 6B

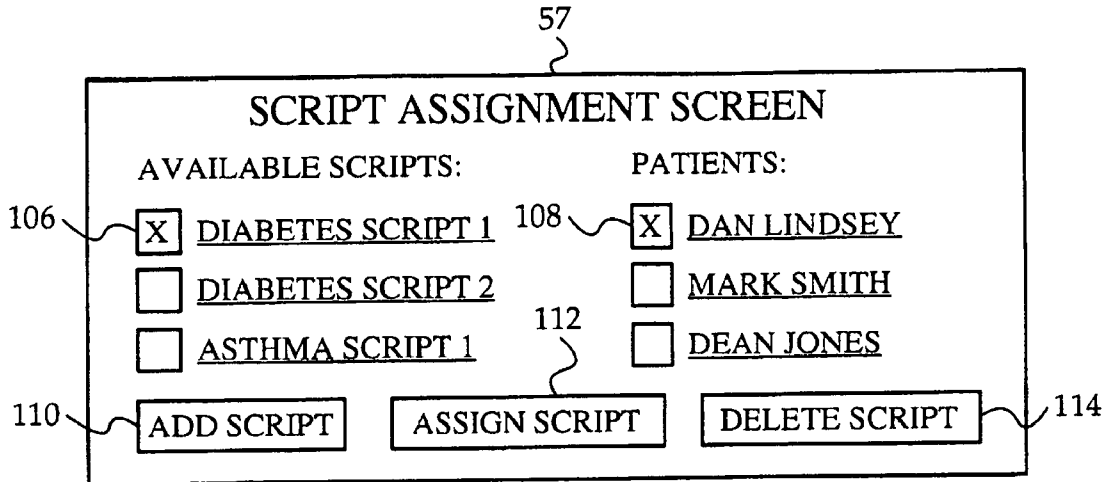


FIG. 7

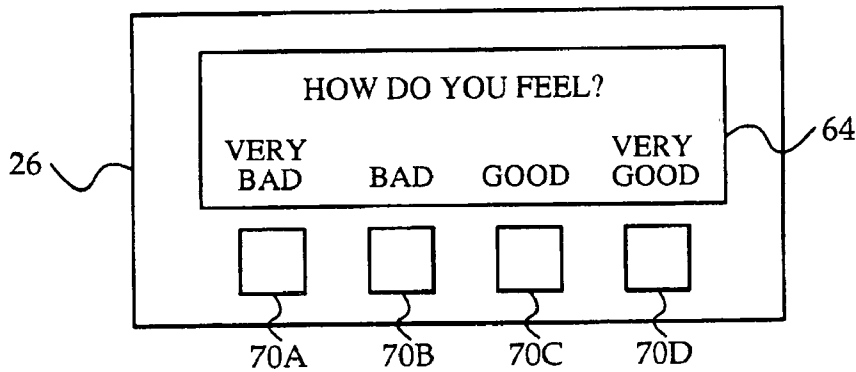


FIG. 8

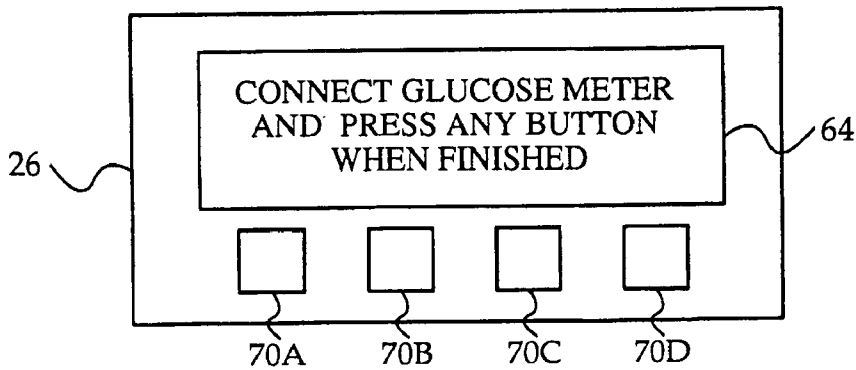


FIG. 9

58

PATIENT REPORT

PATIENT:

DATE OF MEASUREMENT:

42

116

QUERY RESPONSES

HOW DO YOU FEEL?

HOW WELL ARE YOU
MANAGING YOUR DISEASE?

HOW HARD IS IT FOR YOU TO
FOLLOW YOUR TREATMENT PLAN?

HOW HARD IS IT FOR YOU TO
CONTROL YOUR BLOOD SUGAR?

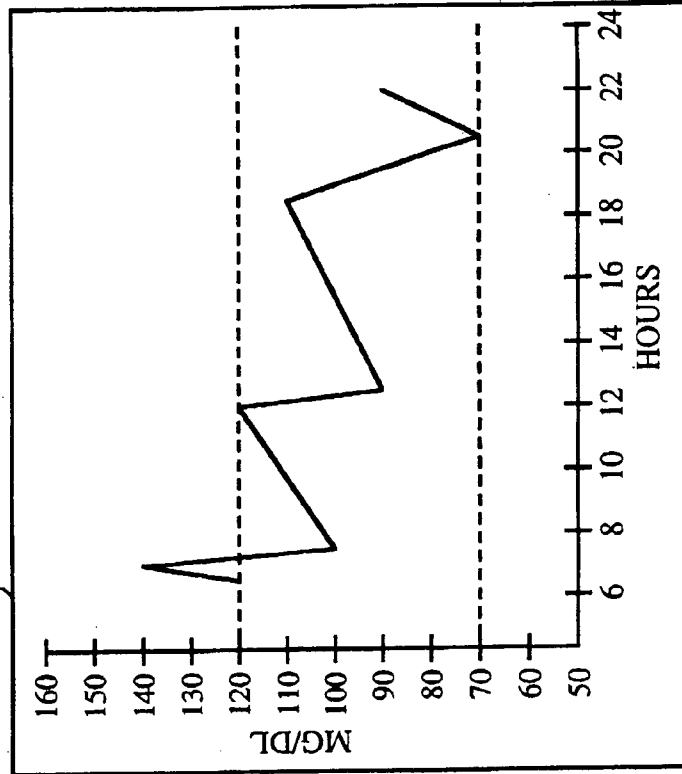


FIG. 10

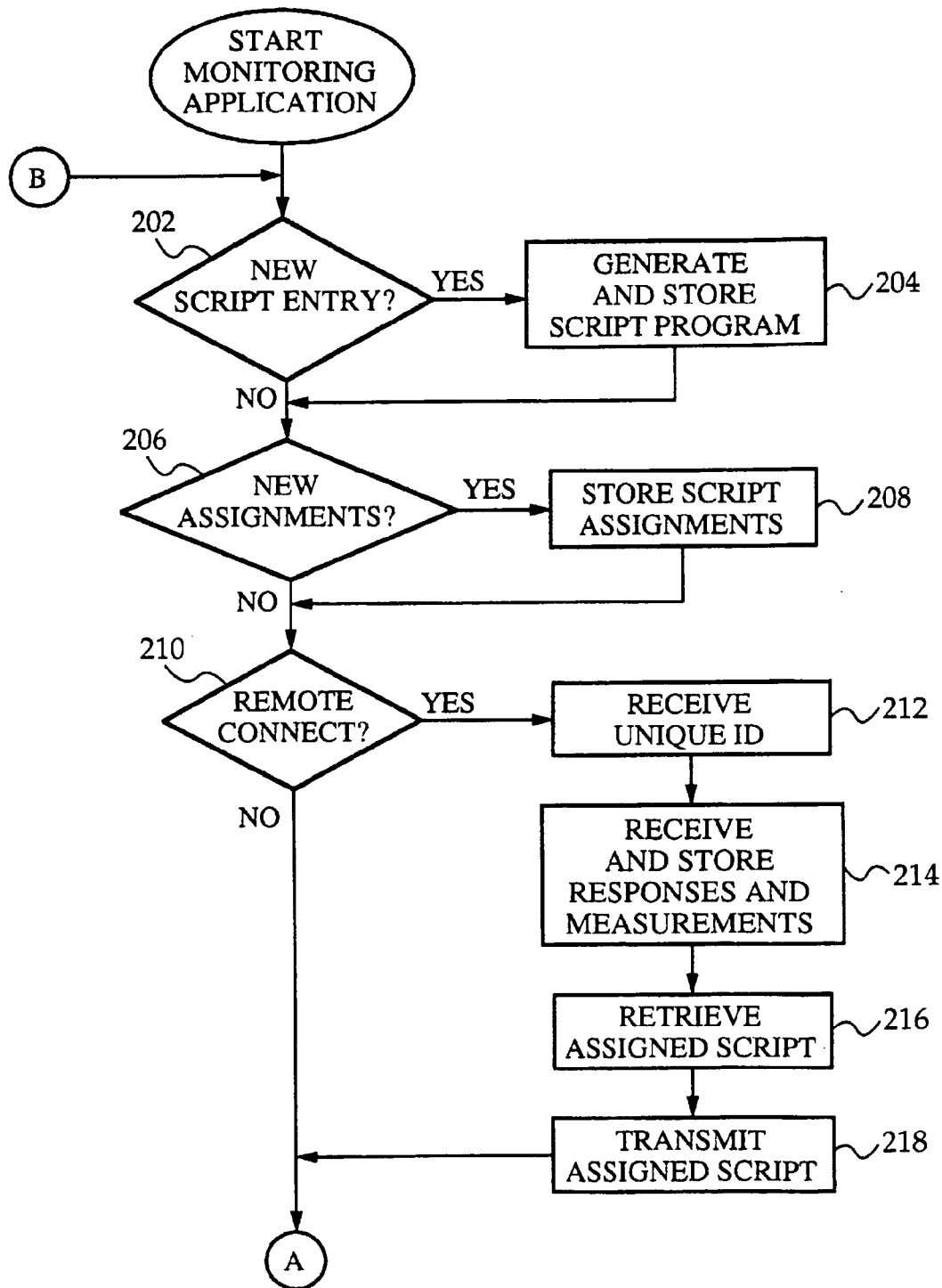


FIG. 11A

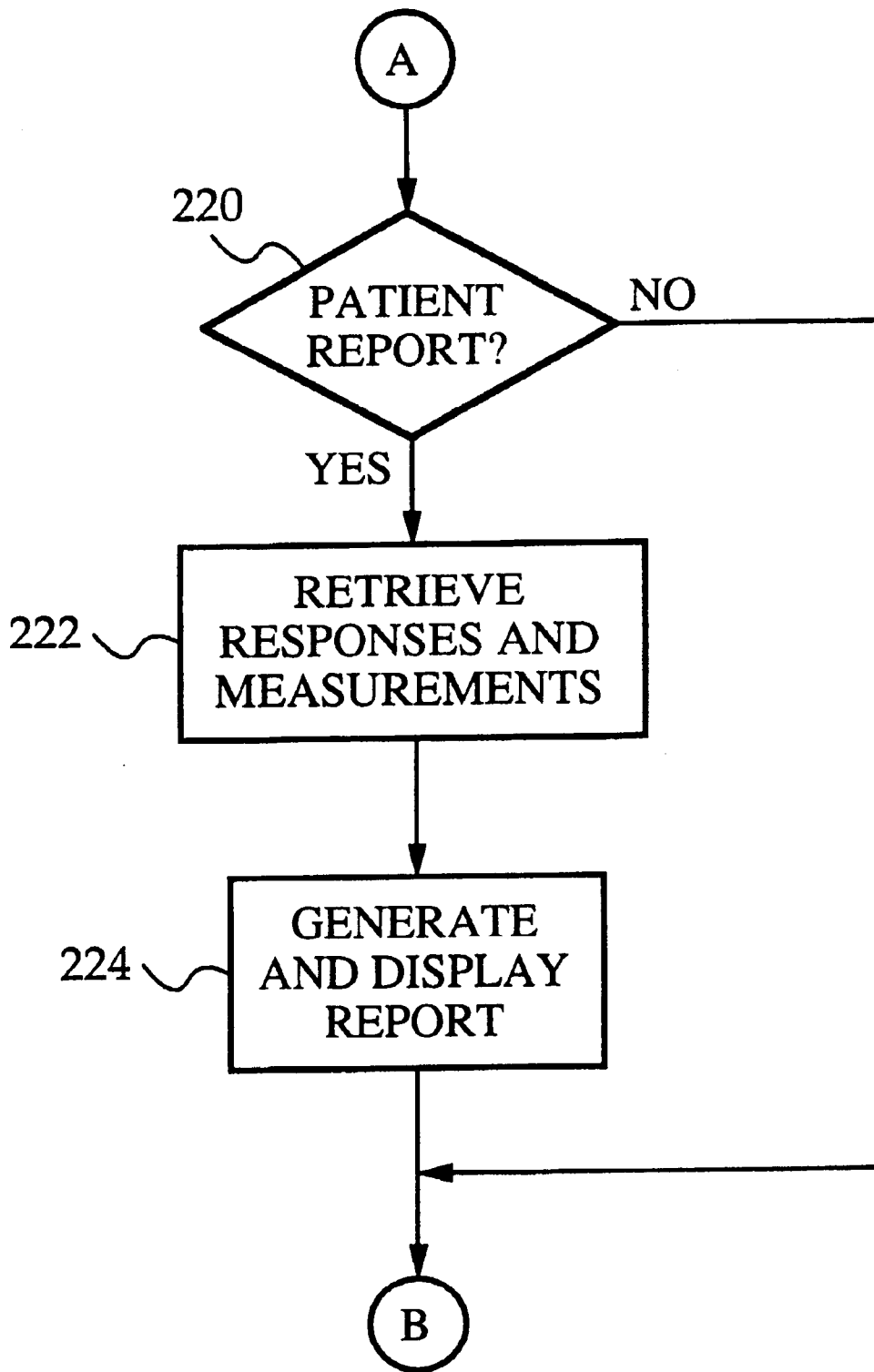


FIG. 11B

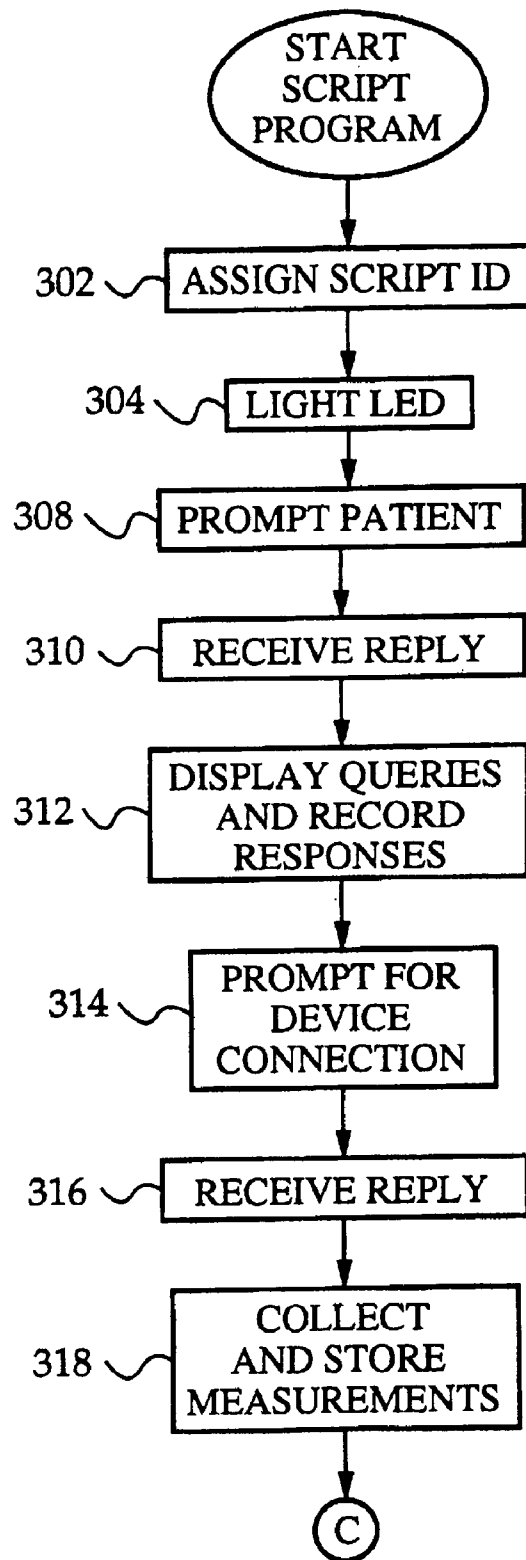


FIG. 12A

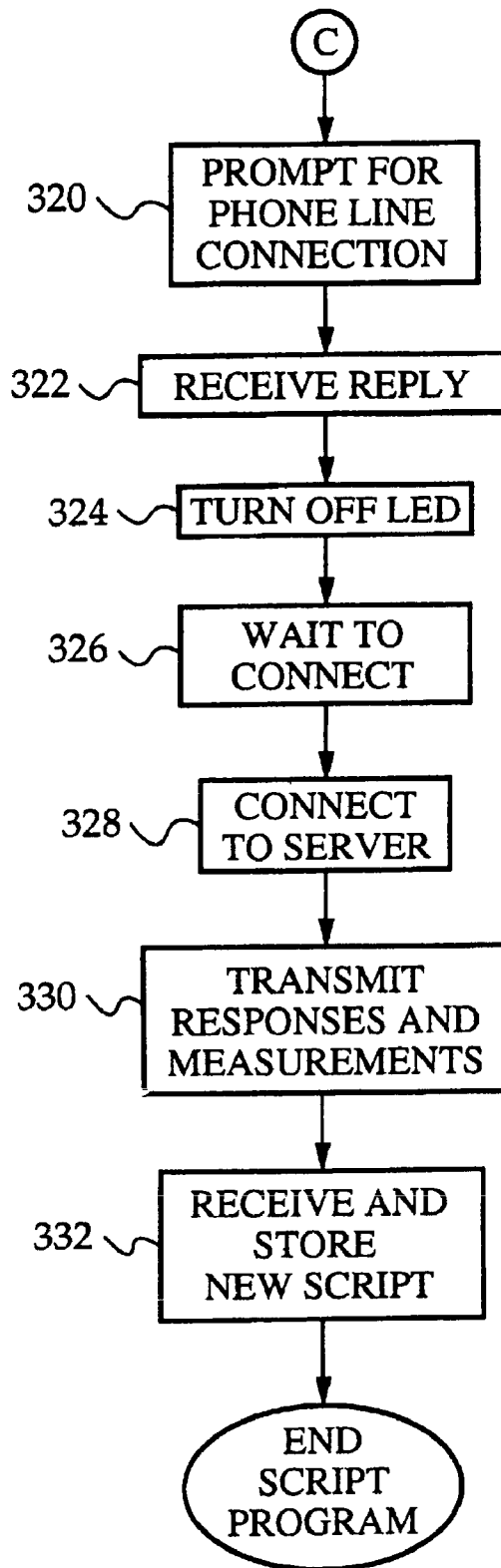


FIG. 12B

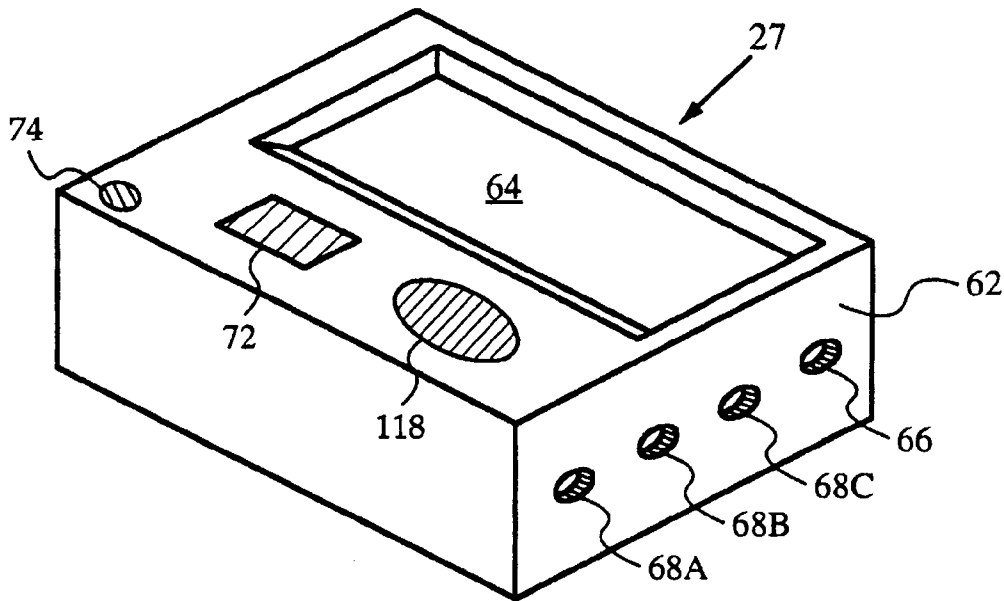


FIG. 13

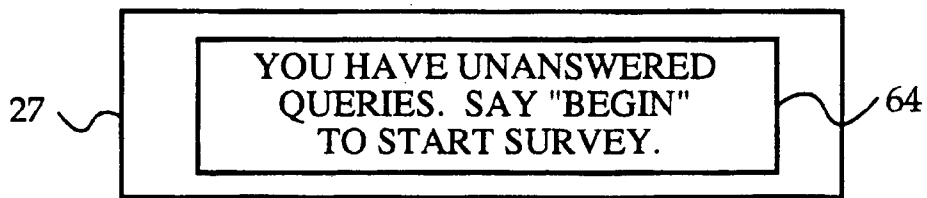


FIG. 14

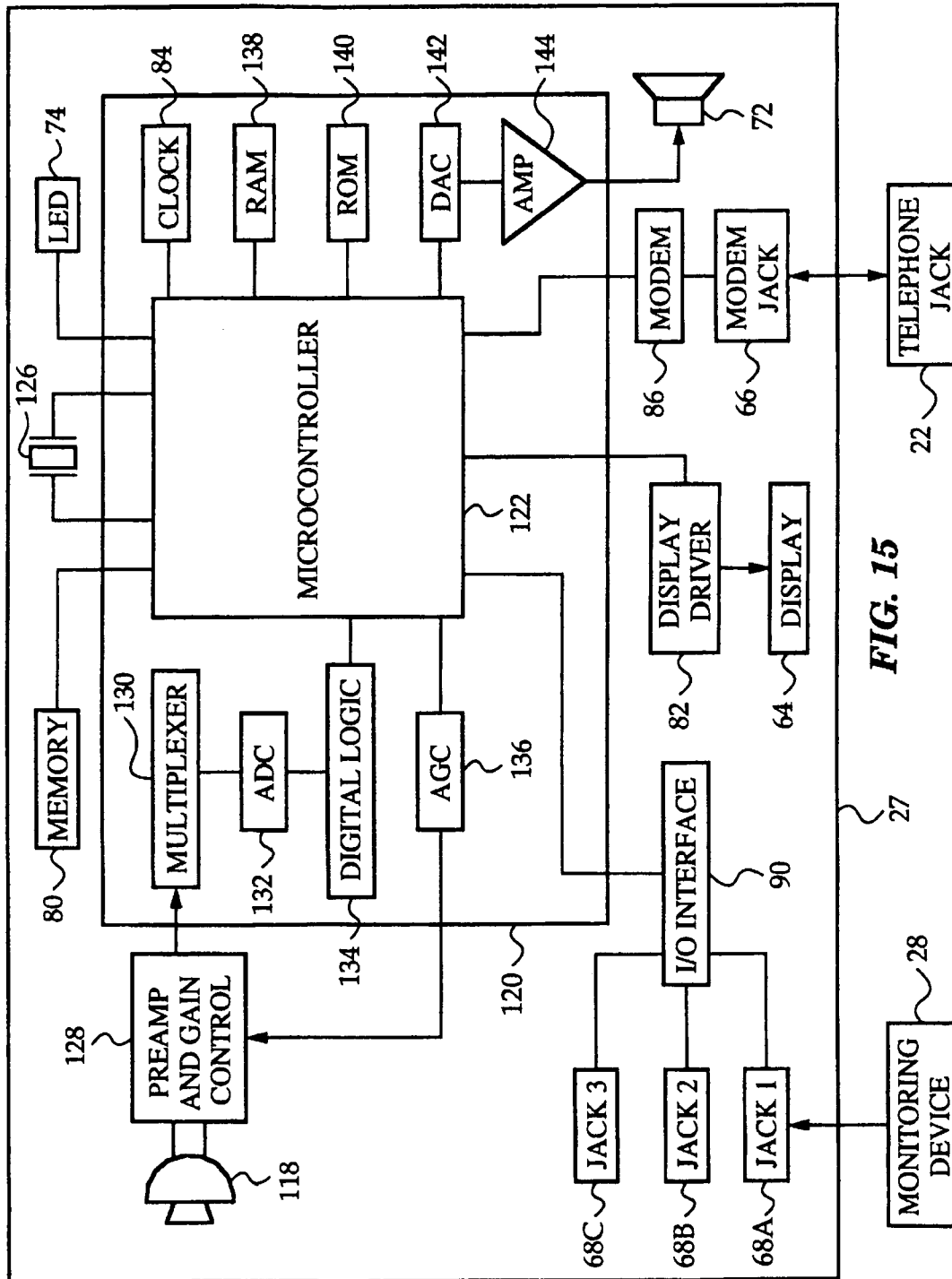


FIG. 15

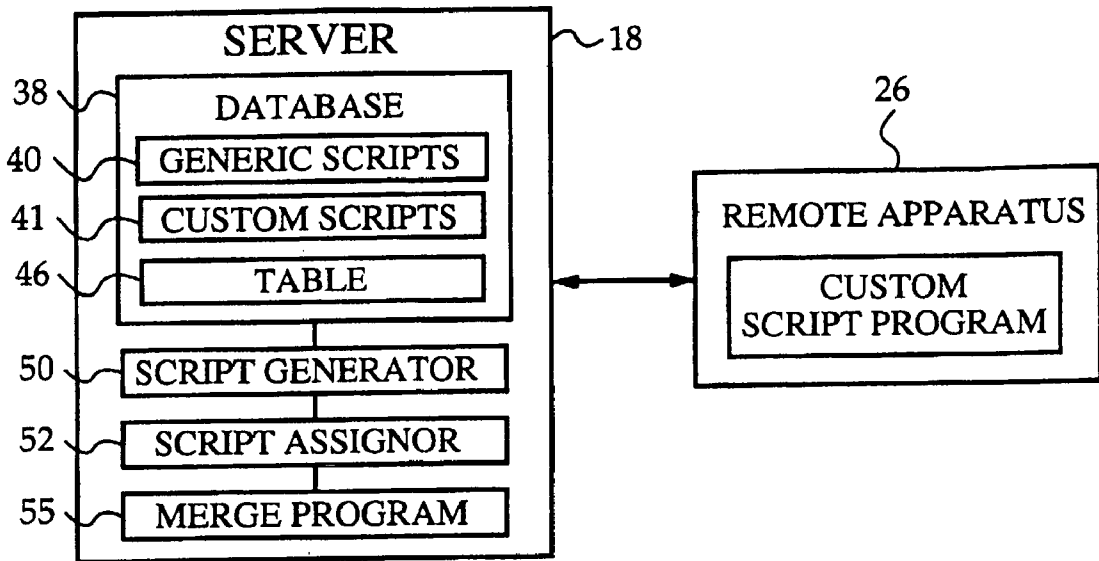


FIG. 16

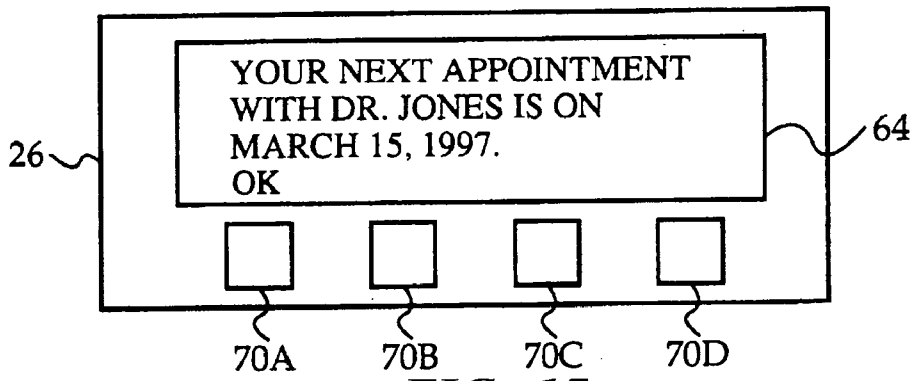


FIG. 17

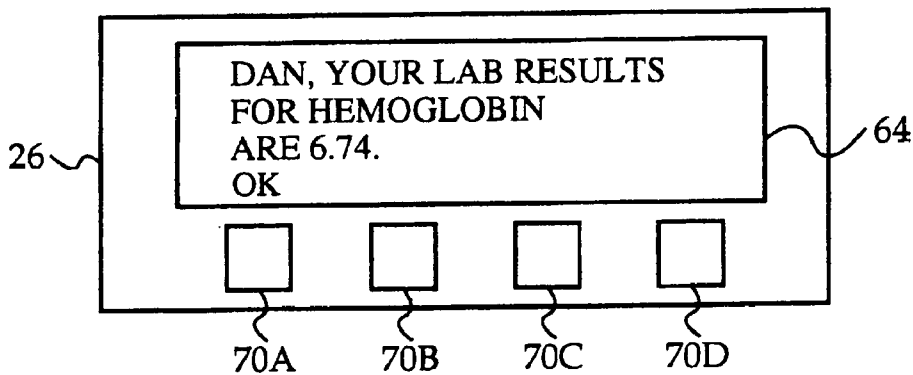


FIG. 18

56

SCRIPT ENTRY SCREEN

SCRIPT NAME: 92

STATEMENTS

	CHOICE 1	CHOICE 2	CHOICE 3	CHOICE 4
YOUR NEXT APPOINTMENT WITH <<INSERT PHYSICIAN_NAME>> IS ON <<INSERT APPOINTMENT_DATE>>	OK	<input type="text"/>	<input type="text"/>	<input type="text"/> 96
<<INSERT PATIENT_NAME>>, YOUR LAB RESULTS FOR HEMOGLOBIN ARE <<INSERT HbA1c_RESULT>>	OK	<input type="text"/>	<input type="text"/>	<input type="text"/>
<<INSERT PATIENT_NAME>>, REMEMBER TO EXERCISE CONSISTENTLY	OK	<input type="text"/>	<input type="text"/>	<input type="text"/>

94

CONNECTION TIME: 100

102 104

FIG. 19

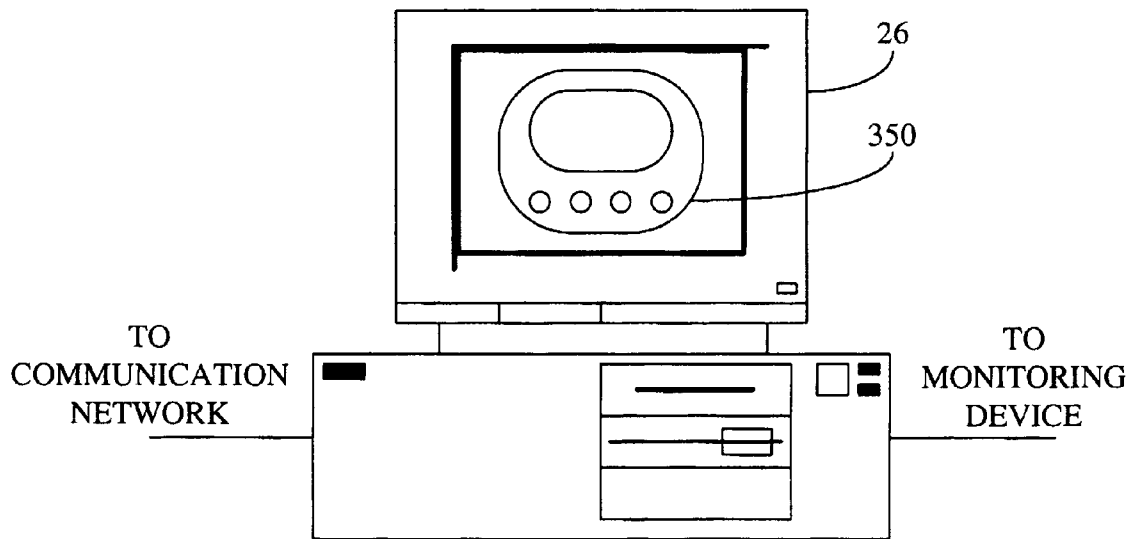


FIG. 20

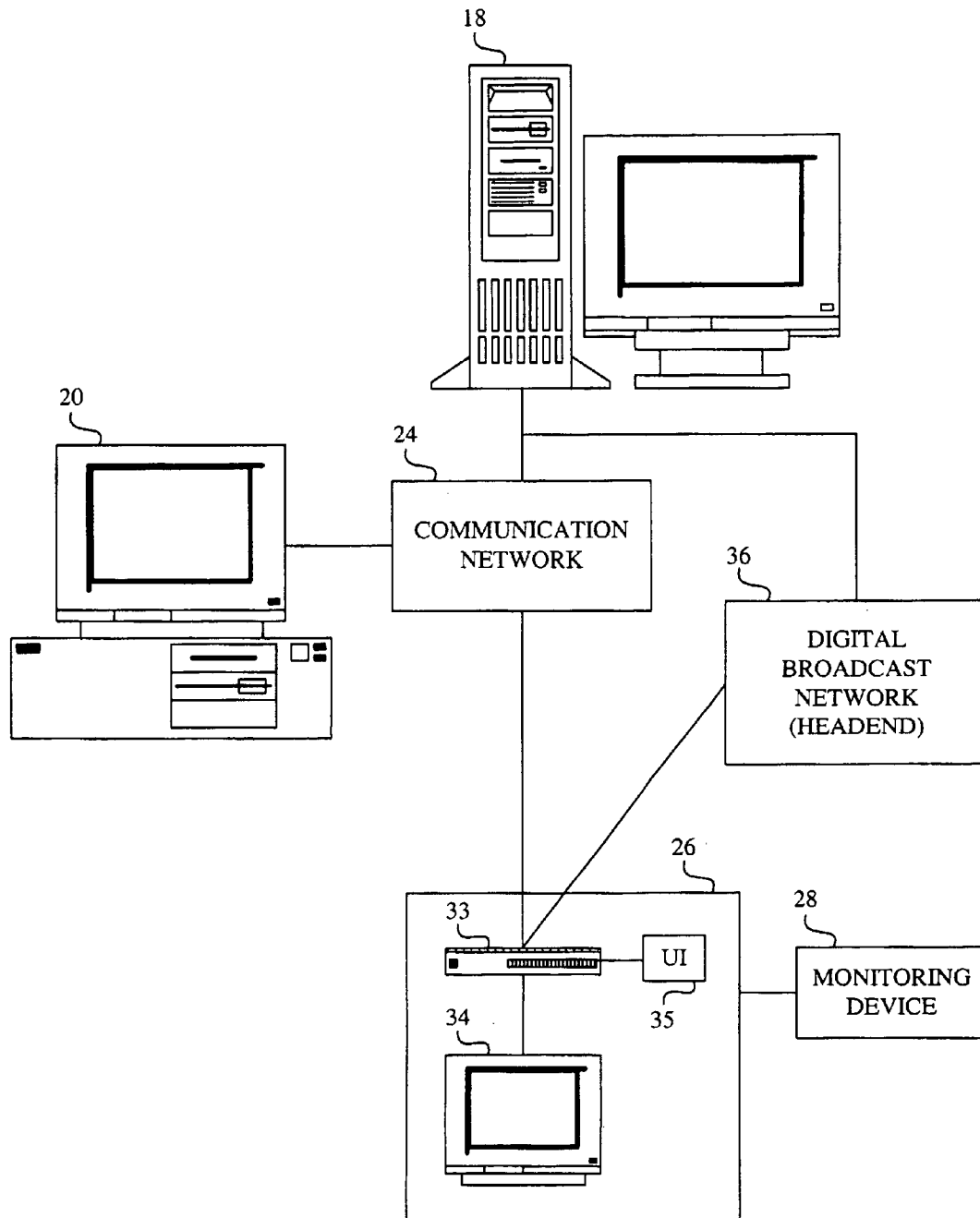
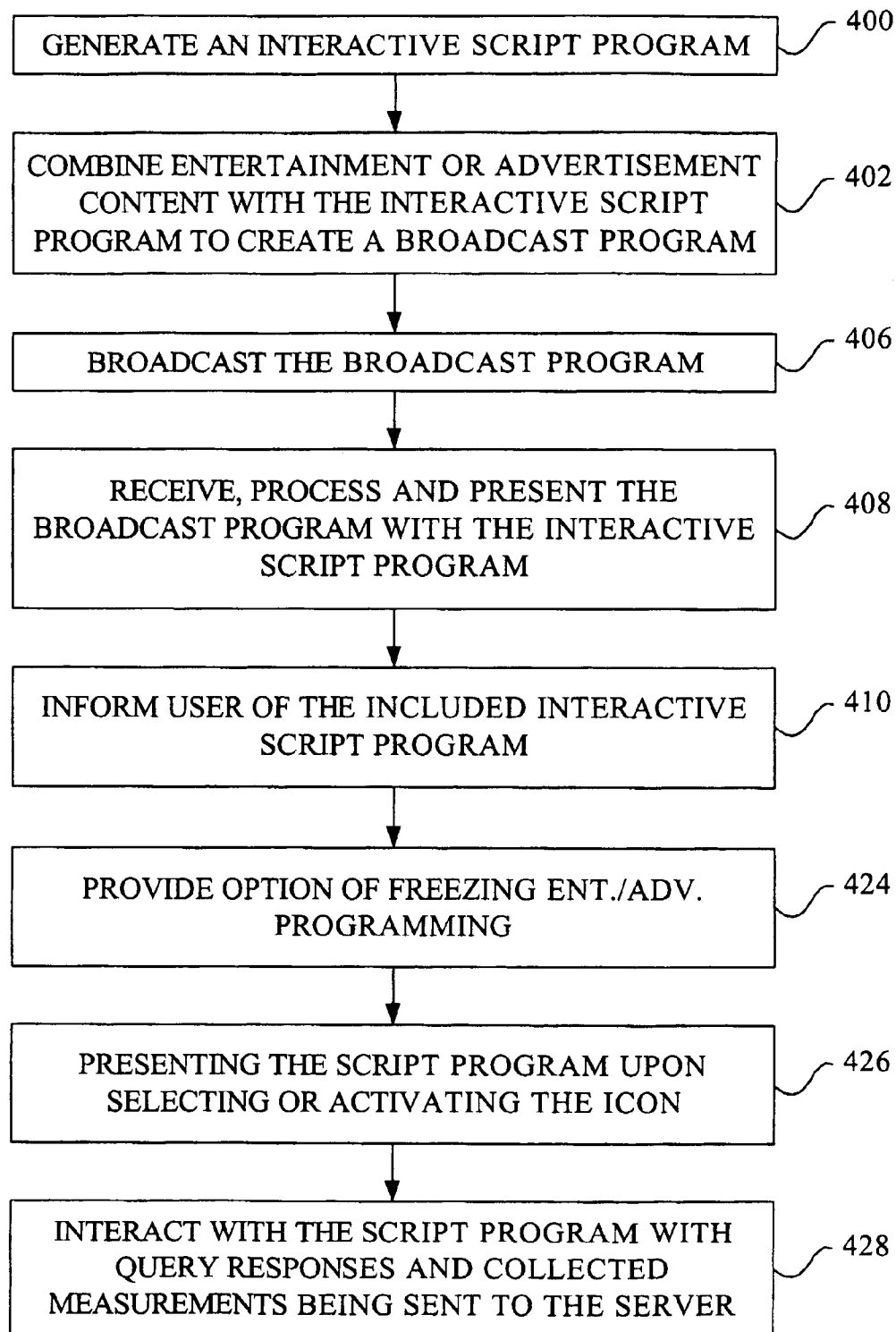


FIG. 21

**FIG. 22**

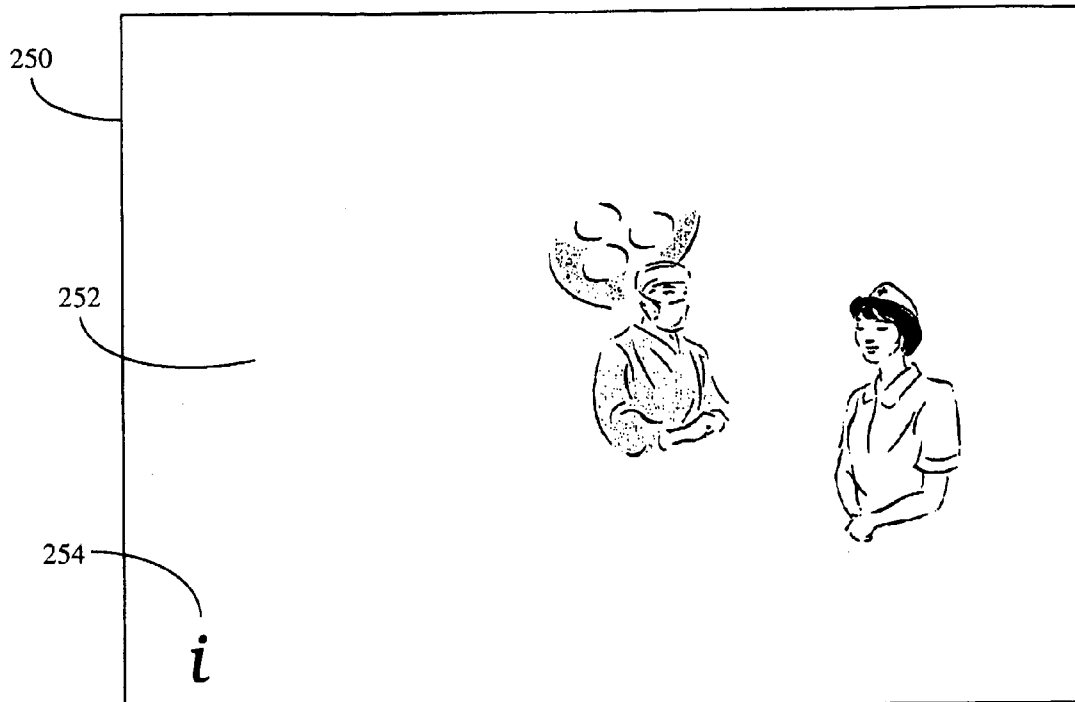


FIG. 23

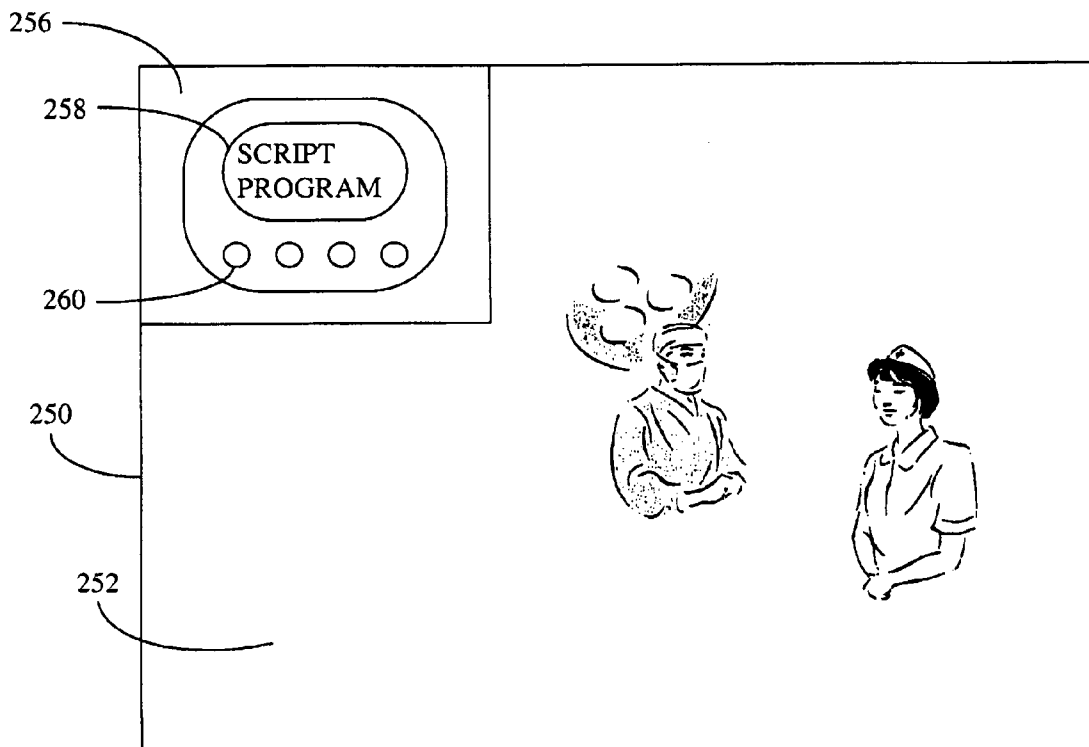


FIG. 24

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**NETWORKED SYSTEM FOR INTERACTIVE
COMMUNICATION AND REMOTE
MONITORING OF INDIVIDUALS**

PRIORITY CLAIM

This application is a continuation of U.S. patent application Ser. No. 09/658,209, filed Sep. 8, 2000, now U.S. Pat. No. 6,968,375, which is a continuation-in-part of U.S. patent application Ser. No. 09/300,856, filed Apr. 28, 1999, now U.S. Pat. No. 6,368,273, which is a divisional application of U.S. patent application Ser. No. 08/946,341, filed Oct. 7, 1997, now U.S. Pat. No. 5,997,476, which is a continuation-in-part of U.S. patent application Ser. No. 08/847,009, filed Apr. 30, 1997, now U.S. Pat. No. 5,897,493, which, in turn claims priority from U.S. Provisional Application Ser. Nos. 60/041,746 and 60/041,751, both filed Mar. 28, 1997.

RELATED APPLICATIONS

This application is also related to:

(i) U.S. Pat. Nos. 5,985,559 and 6,101,478, both continuations-in-part of U.S. Pat. No. 5,897,493;

(ii) U.S. Pat. No. 6,248,065, a divisional of U.S. Pat. No. 5,897,493;

(iii) U.S. Pat. No. 6,270,455, a continuation-in-part of U.S. Pat. No. 5,997,476;

(iv) U.S. Pat. No. 6,381,577, which is a continuation of U.S. Pat. No. 6,101,478;

(v) Abandoned U.S. patent application Ser. No. 09/531,237, a continuation-in-part of U.S. Pat. Nos. 6,368,273 and 09/378,188, a continuation of U.S. Patent No. 5,985,559; and

(vi) Co-pending U.S. patent application Ser. No. 10/279,749, which is a continuation-in-part of U.S. patent application Ser. No., 10/233,296, which is a continuation-in-part of co-pending U.S. patent application Ser. No. 09/665,442, which is also continuation-in-part of U.S. Pat. No. 6,381,577. This application is also related to U.S. patent application Ser. No. 11/093,168, entitled "REMOTE HEALTH MONITORING APPARATUS USING SCRIPTED COMMUNICATIONS" and filed on Mar. 28, 2005 under Express Mail Number EV534 876 838US.

FIELD OF THE INVENTION

The present invention relates generally to communication systems for remote monitoring of individuals, and in particular to a networked system for remotely monitoring individuals and for communicating information to the individuals through the use of script programs.

BACKGROUND OF THE INVENTION

In the United States alone, over 100 million people have chronic health conditions, accounting for an estimated \$700 billion in annual medical costs. In an effort to control these medical costs, many healthcare providers have initiated outpatient or home healthcare programs for their patients. The potential benefits of these programs are particularly great for chronically ill patients who must treat their diseases on a daily basis. However, the success of these programs is dependent upon the ability of the healthcare providers to monitor the patients remotely to avert medical problems before they become complicated and costly. Further, success requires compliance with the program, which is often dependent on providing messages or other reminders to patients so

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that they will stay with the program. Unfortunately, no convenient and cost effective monitoring system exists to accomplish these objectives. While these problems are particularly acute for the poor and the elderly, all demographic groups could significantly benefit from remote communication and monitoring systems.

Prior attempts to monitor patients remotely have included the use of personal computers and modems to establish communication between patients and healthcare providers, either directly or via an Internet site. However, computers are too expensive to give away and the patients who already own computers are only a fraction of the total population.

Other attempts to monitor patients remotely have included the use of medical monitoring devices with built-in modems. Examples of such monitoring devices include blood glucose meters, respiratory flow meters, and heart rate monitors. While these devices can be quite successful, their multimedia capabilities are often limited. In addition, many patients simply may prefer to interact with a device they are more familiar with, such as a television.

Prior attempts to monitor patients remotely have also included the use of interactive telephone or video response systems. Such interactive systems are disclosed in U.S. Pat. No. 5,390,238 issued to Kirk et al. on Feb. 14, 1995, U.S. Pat. No. 5,434,611 issued to Tamura on Jul. 18, 1995, and U.S. Pat. No. 5,441,047 issued to David et al. on Aug. 15, 1995. One disadvantage of these systems is that they either require a patient to call in to a central facility to be monitored or require the central facility to call the patient according to a rigid monitoring schedule.

If the patients are required to call the central facility, only the compliant patients will actually call regularly to be monitored. Non-compliant patients will typically wait until an emergency situation develops before contacting their healthcare provider, thus defeating the purpose of the monitoring system. If the central facility calls each patient according to a monitoring schedule, it is intrusive to the patient's life and resistance to the monitoring grows over time. Further, it is difficult to identify each patient uniquely using these systems. Moreover, these systems are generally incapable of collecting medical data from monitoring devices, such as blood glucose meters, respiratory flow meters, or heart rate monitors.

As such, there exists a need for a simple and inexpensive system for remotely monitoring patients and for easily communicating information to the patients. There is also a need to encourage patient's compliance with a prescribed treatment plan.

SUMMARY

The present invention provides a system for remotely interacting with an individual. The system includes a server, a remote interface device for assigning in the server a set of queries to be answered by the individual, a remotely programmable apparatus for interacting with the individual and a broadcaster in communication with the server and the remotely programmable apparatus.

By using the entertainment medium of interactive television with its ability to receive a large bandwidth of data, the present invention can more easily communicate interactive entertaining/educational information to potential and existing patients. The interactive nature of the received data makes it easy for a user to access interactive programs related to corresponding entertainment/advertisement content or related to user adherence to a predefined regimen.

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In accordance with another aspect of the present invention, an answering service sends a series of questions as voice communication from a stored set of questions to the remote apparatus for the individual to respond to, when the voice communication button is activated. The answering service stores responses to each provided question in the series of questions and provides a service based on the individual's response to the questions. The provided service is communication with a health care professional or a service provider. Also, the answering service includes a speech recognition component for receiving spoken responses to the series of questions and a speech synthesis component for making the set of queries into a series of questions.

In accordance with yet another aspect of the present invention, the remotely programmable apparatus includes an appliance component for providing appliance functionality. The appliance component is an alarm clock, a kitchen appliance, or an entertainment device.

In accordance with still another aspect of the present invention, the remotely programmable apparatus includes a monitoring component for producing measurements of a physiological condition of the individual.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a block diagram of networked system formed in accordance with a first embodiment of the present invention;

FIG. 2 is a block diagram illustrating the interaction of the components of the system of FIG. 1;

FIG. 3 is a perspective view of a remotely programmable apparatus of the system of FIG. 1;

FIG. 4 is a block diagram illustrating the components of the apparatus of FIG. 3;

FIG. 5 is a script entry screen according to the preferred embodiment of the invention;

FIG. 6A is a listing of a sample script program according to the preferred embodiment of the invention;

FIG. 6B is a continuation of the listing of FIG. 6A;

FIG. 7 is a script assignment screen according to the preferred embodiment of the invention

FIG. 8 is a sample query appearing on the apparatus of FIGS. 1A-D;

FIG. 9 is a sample prompt appearing on the display of the apparatus of FIG. 3;

FIG. 10 is a sample report displayed on a workstation of the system of FIGS. 1A-D;

FIG. 11A is a flow chart illustrating the steps included in a monitoring application executed by the server of FIGS. 1A-D according to the present invention;

FIG. 11B is a continuation of the flow chart of FIG. 11A

FIG. 12A is a flow chart illustrating the steps included in the script program of FIGS. 6A-6B;

FIG. 12B is a continuation of the flow chart of FIG. 12;

FIG. 13 is a perspective view of a remotely programmable apparatus according to an embodiment of the present invention;

FIG. 14 is a sample prompt appearing on a display of the apparatus of FIG. 13;

FIG. 15 is a block diagram illustrating the components of the apparatus of FIG. 13;

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FIG. 16 is a schematic block diagram illustrating the interaction of the server of FIGS. 1A-D with the apparatus of FIG. 3 according to another embodiment of the present invention;

FIG. 17 is a first sample message appearing on the display of the apparatus of FIG. 3;

FIG. 18 is a second sample message appearing on the display of the apparatus of FIG. 3;

FIG. 19 is a script entry screen according to an embodiment of the present invention;

FIGS. 20 and 21 are block diagrams of alternate embodiments of the present invention;

FIG. 22 is a flow chart illustrating the process performed by the system of FIG. 21; and

FIGS. 23 and 24 are example broadcast programming presentations with an included script program.

DETAILED DESCRIPTION

The present invention provides a system and method for remotely monitoring individuals and for increasing individual use of health programs. In a first embodiment of the invention, the individuals are patients and the system is used to collect data relating to the health status of the patients. However, it is to be understood that the invention is not limited to remote monitoring of patients. The system and method of the invention may be used for any type of remote monitoring and program adherence application. The invention may also be implemented as an automated messaging system for communicating information to individuals, as will be discussed in an alternative embodiment below.

A first embodiment of the invention is illustrated in FIGS. 1A and 2-12. Referring to FIG. 1, a networked system 16 includes a server 18 and a workstation 20 connected to the server 18 through a communication network 24. The server 18 is preferably a world wide web skilled in the art that the server 18 may comprise a single stand-alone computer or multiple computers distributed throughout a network. The workstation 20 is preferably a personal computer, remote terminal, or web TV unit connected to the server 18 via the Internet. The workstation 20 functions as a remote interface for entering in the server 18 messages and queries to be communicated to the patients.

The system 16 also includes multiple remotely programmable apparatus, such as first and second apparatuses 26 for monitoring multiple patients. Each apparatus 26 is designed to interact with a patient in accordance with script programs received from the server 18. Each apparatus 26 is in communication with the server 18 through the communication network 24, preferably the Internet. Alternatively, each apparatus 26 may be placed in communication with the server 18 via wireless communication networks, cellular networks, telephone networks, satellite networks or any other network which allows each apparatus 26 to exchange data with the server 18. It is to be understood that the system 16 may include any number of remotely programmable apparatuses for monitoring any number of patients.

In the preferred embodiment, each patient to be monitored is also provided with a monitoring device 28. The monitoring device 28 is designed to produce measurements of a physiological condition of the patient, record the measurements, and transmit the measurements to the patient's remotely programmable apparatus through a standard connection cable 30. Examples of suitable monitoring devices 28 include blood glucose meters, respiratory flow meters, blood pressure cuffs, electronic weight scales, and pulse rate monitors. Such monitoring devices are well known in the

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art. The specific type of monitoring device **28** provided to each patient is dependent upon the patient's disease or health treatment needs. For example, diabetes patients are provided with a blood glucose meter for measuring blood glucose concentrations, asthma patients are provided with respiratory flow meters for measuring peak flow rates, obesity patients are provided with weight scales, etc.

FIG. **2** shows the server **18**, the workstation **20**, and the apparatus **26** in greater detail. The server **18** includes a database **38** for storing script programs **40**. The script programs **40** are executed by each apparatus **26**, to communicate queries and messages to a patient, receive responses **42** to the queries, collect monitoring device measurements **44**, and to transmit responses **42** and measurements **44** to the server **18**. The database **38** is designed to store responses **42** and measurements **44**. The database **38** further includes a look-up table **46**. The table **46** contains a list of the patients to be monitored, and for each patient, a unique patient identification code and a respective pointer to one or more script programs **40** assigned to the patient. Each remotely programmable apparatus **26** is designed to execute assigned script programs **40** received from the server **18**. The script programs **40** may include queries, reminder messages, informational statements, useful quotations, or other information of benefit to the patient. See Appendix A for example script programs.

FIGS. **3–4** show the structure of a remotely programmable apparatus **26** according to the preferred embodiment. Referring to FIG. **3**, the apparatus **26** includes a housing **62**. The housing **62** is sufficiently compact to enable the apparatus **26** to be hand-held and carried by a patient. The apparatus **26** also includes a display **64** for displaying queries and prompts to the patient. In the preferred embodiment, the display **64** is a liquid crystal display (LCD).

The apparatus **26** includes five user input buttons **70A**, **70B**, **70C**, **70D** and **70E** that are located on the same side of the apparatus **26** as the display **64**. The user input buttons **70A–D** are for entering in the apparatus **26** responses **42** to the queries and prompts. In the preferred embodiment, the user input buttons **70A–D** are momentary contact push buttons. In alternative embodiments, user input buttons **70A–D** may be replaced by switches, keys, a touch sensitive display screen, or any other data input device.

The user input button **70E** is a emergency or other services button and is preferably red, but may be of any size, shape, or color that draws special visual or tactile attention to the user. The services provided by the user input button **70E** are described in more detail below.

Three monitoring device jacks **68A**, **68B**, and **68C** are located on a surface of housing **62**. The device jacks **68A–C** are for connecting the apparatus **26** to a number of monitoring devices **28**, such as blood glucose meters, respiratory flow meters, or blood pressure cuffs (not shown in FIG. **3**). The apparatus **26** also includes a modem jack **66** for connecting the apparatus **26** to a telephone jack through a standard connection cord (not shown). The apparatus **26** further includes a visual indicator, such as a light emitting diode (LED) **74**. The LED **74** is for visually notifying the patient that he or she has unanswered queries stored in the apparatus **26**.

FIG. **4** is a schematic block diagram illustrating the components of the apparatus **26** in greater detail. The apparatus **26** includes a microprocessor **76** and a memory **80** connected to the microprocessor **76**. The memory **80** is preferably a non-volatile memory, such as a serial EEPROM. The memory **80** stores script programs **40** received from the server **18**, measurements **44** received from

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the monitoring device **28**, responses **42** to queries. The microprocessor **76** also includes built-in read only memory (ROM), which stores firmware for controlling the operation of the apparatus **26**. The firmware includes a script interpreter used by the microprocessor **76** to execute the script programs **40**. The script interpreter interprets script commands, which are executed by the microprocessor **76**. Specific techniques for interpreting and executing script commands in this manner are well known in the art.

The microprocessor **76** is preferably connected to memory **80** using a standard two-wire interface. The microprocessor **76** is also connected to the user input buttons **70**, the LED **74**, a clock **84**, and a display driver **82**. The clock **84** indicates the current date and time to the microprocessor **76**. For clarity of illustration, clock **84** is shown as a separate component, but is preferably built into the microprocessor **76**. The display driver **82** operates under the control of the microprocessor **76** to display information on the display **64**. The microprocessor **76** is preferably a PIC 16C65 processor. The modem **86** is connected to a telephone jack **22** through the modem jack **66**. The modem **86** is for exchanging data between the server **18** and the processor **76** through the communication network **24**. The data includes the script programs **40** which are received from the server **18** as well as the responses **42** to queries, the device measurements **44**, the script identification codes, and the patient's unique identification code, which the modem **86** transmits to the server **18**. The modem **86** is preferably a complete 28.8 K modem commercially available from Cermetek, although any suitable modem may be used. The processor **76** also includes a component that connects to the telephone jack **22** and a microphone **88** and a speaker **89**, thereby allowing telephone calls to be processed.

The device interface **90** is connected to the device jacks **68A**, **68B**, and **68C**. The device interface **90** is for interfacing with a number of monitoring devices **28**, such as blood glucose meters respiratory flow meters, blood pressure cuffs, weight scales, or pulse rate monitors, through device jacks **68A–C**.

The device interface **90** operates under the control of the microprocessor **76** to collect measurements **44** from the monitoring devices **28** and to output the measurements to the microprocessor **76** for storage in the memory **80**. In the preferred embodiment, the interface **90** is a standard RS232 interface. For simplicity of illustration, only one device interface **90** is shown in FIG. **4**. However, in alternative embodiments, the apparatus **26** may include multiple device interfaces to accommodate monitoring devices that have different connection standards.

Referring again to FIG. **2**, the server **18** includes a monitoring application **48**. The monitoring application **48** is a controlling software application executed by the server **18** to perform the various functions described below. The application **48** includes a script generator **50**, a script assignor **52**, and a report generator **54**. The script generator **50** is designed to generate the script programs **40** from script information entered through the workstation **20**. The script information is entered through a script entry screen **56**. In the preferred embodiment, script entry screen **56** is implemented as a web page on the server **18**. The workstation **20** includes a web browser for accessing the web page to enter the script information.

FIG. **5** illustrates the script entry screen **56** as it appears on the workstation **20**. The screen **56** includes a script name field **92** for specifying the name of a script program to be generated. The screen **56** also includes entry fields **94** for entering a set of queries to be answered by a patient. Each

entry field **94** has corresponding response choice fields **96** for entering response choices for the query. The screen **56** further includes check boxes **98** for selecting a desired monitoring device **28**, such as a blood glucose meter, respiratory flow meter, or blood pressure cuff, from which to collect measurements **44**.

The screen **56** additionally includes a connection time field **100** for specifying a prescribed connection time at which each apparatus **26** executing the script is to establish a subsequent communication link to the server **18**. The connection time is preferably selected to be the time at which communication rates are the lowest, such as 3:00 AM. The screen **56** also includes a CREATE SCRIPT button **102** for instructing script generator **50** to generate a script program **40** from the information entered in screen **56**. The screen **56** further includes a CANCEL button **104** for canceling the information entered in screen **56**.

In the preferred embodiment, each script program **40** created by script generator **50** conforms to the standard file format used on UNIX systems. In the standard file format, each command is listed in the upper case and followed by a colon. Every line in the script program **40** is terminated by a linefeed character {LF}, and only one command is placed on each line. The last character in the script program **40** is a UNIX end of file character {EOF}. Table 1 shows an exemplary listing of script commands used in the preferred embodiment of the invention.

TABLE 1

SCRIPT COMMANDS	
Command	Description
CLS: {LF}	Clear the display.
ZAP: {LF}	Erase from memory the last set of query responses recorded.
LED: b{LF}	Turn the LED on or off, where b is a binary digit of 0 or 1. An argument of 1 turns on the LED, and an argument of 0 turns off the LED.
DISPLAY: {chars} {LF}	Display the text following the DISPLAY command.
INPUT: mmmm{LF}	Record a button press. The m's represent a button mask pattern for each of the four input buttons. Each m contains an "X" for disallowed buttons or an "O" for allowed buttons. For example, INPUT: OXOX{LF} allows the user to press either button #1 or #3.
WAIT: {LF}	Wait for any one button to be pressed, then continue executing the script program.
COLLECT: device{LF}	Collect measurements from the monitoring device specified in the COLLECT command. The user is preferably prompted to connect the specified monitoring device to the apparatus and press a button to continue.
NUMBER: aaaa{LF}	Assign a script identification code to the script program. The script identification code from the most recently executed NUMBER statement is subsequently transmitted to the server along with the query responses and device measurements. The script identification code identifies to the server which script program was most recently executed by the remote apparatus.
DELAY: t{LF}	Wait until time t specified in the DELAY command, usually the prescribed connection time.
CONNECT: {LF}	Perform a connection routine to establish a communication link to the server, transmit the patient identification code, query responses, device measurements, and script identification code to the server, and receive and store a new script program. When the server instructs the apparatus to disconnect, the script interpreter is restarted, allowing the new script program to execute.

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The script commands illustrated in Table 1 are representative of the preferred embodiment and are not intended to limit the scope of the invention. After consideration of the ensuing description, it will be apparent to one skilled in the art many other suitable scripting languages and sets of script commands may be used to implement the invention.

The script generator **50** preferably stores a script program template which it uses to create each script program **40**. To generate a script program **40**, the script generator **50** inserts into the template the script information entered in the screen **56**. For example, FIGS. 6A–6B illustrate a sample script program **40** created by the script generator **50** from the script information shown in FIG. 5.

The script program **40** includes display commands to display the queries and response choices entered in fields **94** and **96**, respectively. The script program **40** also includes input commands to receive responses **42** to the queries. The script program **40** further includes a collect command to collect device measurements **44** from the monitoring device **28** specified in the check boxes **98**. The script program **40** also includes commands to establish a subsequent communication link to the server **18** at the connection time specified in field **100** FIG. 5. The steps included in the script program **40** are also shown in the flow chart of FIGS. 12A–12B and will be discussed in the operation section below.

Referring again to FIG. 2, the script assignor **52** is used to assign script programs **40** to the patients. The script programs **40** are assigned in accordance with script assignment information entered through workstation **20**. The script assignment information is entered through a script assignment screen **57**, which is preferably implemented as a web page on the server **18**.

FIG. 7 illustrates a sample script assignment screen **57** as it appears on workstation **20**. The screen **57** includes check boxes **106** for selecting a script program **40** to be assigned, and check boxes **108** for selecting the patients to whom the script program is to be assigned. The screen **57** also includes an ASSIGN SCRIPT button **112** for entering the assignments. When button **112** is pressed, the script assignor **52** creates and stores for each patient selected in check boxes **108** a respective pointer to the script program **40** selected in the check boxes **106**. Each pointer is stored in the patient look-up table **46** of the database **38**. The screen **57** further includes an ADD SCRIPT button **110** for accessing the script entry screen and a DELETE SCRIPT button **114** for deleting a script program **40**.

Referring again to FIG. 2, the report generator **54** is designed to generate a patient report **58** from the responses **42** and the device measurements **44** received in the server **18**. The patient report **58** is displayed on the workstation **20**. FIG. 10 shows a sample patient report **58** produced by the report generator **54** for a selected patient. The patient report **58** includes a graph **116** of the device measurements **44** received from the patient, as well as a listing of the responses **42** received from the patient. Specific techniques for writing a report generator program to display data in this manner are well known in the art.

The operation of the preferred embodiment is illustrated in FIGS. 1–12. FIG. 11A is a flow chart illustrating steps included in the monitoring application executed by the server **18**. FIG. 11B is a continuation of the flow chart of FIG. 11A. In step **202**, the server **18** determines if new script information has been entered through the script entry screen **56**. If new script information has not been entered, the server **18** proceeds to step **206**. If new script information has been entered, the server **18** proceeds to step **204**.

As shown in FIG. 5, the script information includes a set of queries, and for each of the queries, corresponding response choices. The script information also includes a selected monitoring device type from which to collect device measurements 44. The script information further includes a prescribed connection time for each apparatus to establish a subsequent communication link to the server 18. The script information is generally entered in the server 18 by a healthcare provider, such as the patients' physician or case manager. Of course, any person desiring to communicate with the patients may also be granted access to the server 18 to create and assign script programs 40. Further, it is to be understood that system 16 may include any number of remote interfaces for entering script generation and script assignment information in the server 18.

In step 204, the script generator 50 generates a script program from the information entered in the screen 56. The script program is stored in the database 38. Steps 202 and 204 are preferably repeated to generate multiple script programs, e.g. a script program for diabetes patients, a script program for asthma patients, etc. Each script program corresponds to a respective one of the sets of queries entered through the script entry screen 56. Following step 204, the server 18 proceeds to step 206.

In step 206, the server 18 determines if new script assignment information has been entered through the assignment screen 57. If new script assignment information has not been entered, the server 18 proceeds to step 210. If new script assignment information has been entered, the server 18 proceeds to step 208. As shown in FIG. 7, the script programs are assigned to each patient by selecting a script program through check boxes 106, selecting the patients to whom the selected script program is to be assigned through check boxes 108, and pressing the ASSIGN SCRIPT button 112. When button 112 is pressed, the script assignor 52 creates for each patient selected in the check boxes 108 a respective pointer to the script program selected in the check boxes 106. In step 208, each pointer is stored in the look-up table 46 of the database 3.8. Following step 208, the server 18 proceeds to step 210.

In step 210, the server 18 determines if any of the apparatuses are remotely connected to the server. Each patient to be monitored is preferably provided with his or her own remotely programmable apparatus, which has the patient's unique identification code, stored therein. Each patient is thus uniquely associated with: a respective one of the apparatuses. If none of the apparatuses is connected, the server 18 proceeds to step 220. If an apparatus is connected, the server 18 receives from the apparatus the patient's unique identification code in step 212. In step 214, the server 18 receives from the apparatus 26 the query responses 42, device measurements 44, and script identification code recorded during execution of a previously assigned script program. The script identification code identifies to the server 18 which script program was executed by the apparatus to record the query responses 42 and device measurements 44. The responses, device measurements, and script identification code are stored in the database 38.

In step 216, the server 18 uses the patient identification code to retrieve from the table 46 the pointer to the script program assigned to the patient. The server 18 then retrieves the assigned script program from the database 38. In step 218, the server 18 transmits the assigned script program to the patient's remotely programmable apparatus through the communication network 24. Following step 218, the server 18 proceeds to step 220.

In step 220, the server 18 determines if a patient report request has been received from the workstation 20. If no report request has been received, the server 18 returns to step 202. If a report request has been received for a selected patient, the server 18 retrieves from the database 38 the measurements 44 and query responses 42 last received from the patient, step 222. In step 224, the server 18 generates and displays the patient report 58 on the workstation 20. As shown in FIG. 10, the report 58 includes the device measurements 44 and query responses 42 last received from the patient. Following step 224, the server 18 returns to step 202.

FIGS. 12A–12B illustrate the steps included in the script program executed by the apparatus 26. Before the script program is received, the apparatus 26 is initially programmed with the patient's unique identification code and the script interpreter used by microprocessor 76 to execute the script program. The initial programming may be achieved during manufacture or during an initial connection to the server 18. Following initial programming, the apparatus 26 receives from the server 18 the script program assigned to the patient associated with the apparatus 26. The script program is received by the modem 86 through a first communication link and stored in the memory 80.

In step 302, microprocessor 76 assigns a script identification code to the script program and stores the script identification code in the memory 80. The script identification code is subsequently transmitted to the server 18 along with the query responses 42 and the device measurements 44 to identify to the server 18 which script program was most recently executed by apparatus 26. In step 304, the microprocessor 76 lights LED 74 to notify the patient that he or she has unanswered queries stored in the apparatus 26. The LED 74 preferably remains lit until the patient answers the queries. In step 306, the microprocessor 76 erases from the memory 80 the last set of query responses recorded.

In step 308, the microprocessor 76 prompts the patient by displaying on the display 64 "ANSWER QUERIES NOW? PRESS ANY BUTTON TO START". In step 310, the microprocessor 76 waits until a reply to the prompt is received from the patient. When a reply is received, the microprocessor 76 proceeds to step 312. In step 312, the microprocessor 76 executes successive display and input commands to display the queries and response choices on the display 64 and to receive responses to the queries.

FIG. 8 illustrates a sample query and its corresponding response choices as they appear on the display 64. The response choices are positioned on the display 64 such that each response choice is located proximate a respective one of input buttons 70A–D. In the preferred embodiment, each response choice is displayed immediately above a respective input button 70A–D. The patient presses the button 70A–D corresponding to his or her response. The microprocessor 76 stores each response in the memory 80.

In steps 314–318, the microprocessor 76 executes commands to collect the device measurements 44 from a selected the monitoring device 28. The script program specifies the selected monitoring device from which to collect the measurements. In step 314, the microprocessor 76 prompts the patient to connect the selected monitoring device 28, for example a blood glucose meter, to one of device jacks 68A–C. A sample prompt is shown in FIG. 9. In step 316, the microprocessor 76 waits until a reply to the prompt is received from the patient. When a reply is received, the microprocessor 76 proceeds to step 318. In step 318, the microprocessor 76 collects device measurements 44

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from the monitoring device 28 through the interface 90. The measurements 44 are stored in the memory 80.

In step 320, the microprocessor 76 prompts the patient to connect the apparatus 26 to the telephone jack 22 so that the apparatus 26 may connect to the server 18 at the prescribed connection time. In step 322, the microprocessor 76 waits until a reply to the prompt is received from the patient. When a reply is received, the microprocessor 76 turns off the LED 74 in step 324. In step 326, the microprocessor 76 waits until it is time to connect to the server 18. The microprocessor 76 compares the connection time specified in the script program to the current time output by the clock 84.

In step 328, the microprocessor 76 establishes a subsequent communication link between the apparatus 26 and the server 18 through the modem 86 and the communication network 24. If the connection fails for any reason, the microprocessor 76 repeats step 328 to get a successful connection. In step 330, the microprocessor 76 transmits the device measurements 44, query responses 42, script identification code, and patient identification code stored in the memory 80 to the server 18 through the subsequent communication link. In step 332, the microprocessor 76 receives through the communication network 24 a new script program from the server 18. The new script program is stored in the memory 80 for subsequent execution by the microprocessor 76. Following step 332, the script program ends.

One advantage of the monitoring system of the present invention is that it allows each patient to select a convenient time to respond to the queries, so that the monitoring system is not intrusive to the patient's schedule. A second advantage of the monitoring system is that it incurs very low communications charges because each remote apparatus connects to the server 18 at times when communication rates are lowest. Moreover, the cost to manufacture each remote apparatus 26 is very low compared to personal computers or internet terminals, so that the monitoring system is highly affordable.

A third advantage of the monitoring system is that it allows each apparatus 26 to be programmed remotely through script programs 40. Patient surveys, connection times, display prompts, selected monitoring devices, patient customization, and other operational details of each apparatus 26 may be easily changed by transmitting a new script program 40 to apparatus 26. Moreover, each script program 40 may be easily created and assigned by remotely accessing the server 18 through the Internet. Thus, the invention provides a powerful, convenient, and inexpensive system for remotely monitoring a large number of patients.

FIGS. 13–15 illustrate a second embodiment of the invention in which each remotely programmable apparatus includes all of the functionality of the first embodiment described above while also including speech recognition and speech synthesis functionality. FIG. 13 shows a perspective view of the remotely programmable apparatus 27 according to the second embodiment. The apparatus 27 includes a speaker 72 for audibly communicating queries and prompts to the patient. The apparatus 27 also includes a microphone 118 for receiving spoken responses to the queries and prompts. The apparatus 27 may optionally include a display 64 for displaying prompts to the patient, as shown in FIG. 14.

FIG. 15 is a schematic block diagram illustrating the components of the apparatus 27 in greater detail. The apparatus 27 is similar in design to the apparatus 26 of the preferred embodiment except that the apparatus 27 includes an audio processor chip 120 in place of the microprocessor 76. The audio processor chip 120 is preferably an RSC-164

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chip commercially available from Sensory Circuits Inc. of 1735 N. First Street, San Jose, Calif. 95112.

The audio processor chip 120 has a microcontroller 122 for executing script programs received from the server 18. A memory 80 is connected to the microcontroller 122. Memory 80 stores the script programs and a script interpreter used by the microcontroller 122 to execute the script programs. The memory 80 also stores measurements received from the monitoring device 28, responses to the queries, script identification codes, and the patient's unique identification code.

The audio processor chip 120 also has built in speech synthesis functionality for synthesizing queries and prompts to a patient through the speaker 72. For speech synthesis, the chip 120 includes a digital to analog converter (DAC) 142 and an amplifier 144. The DAC 142 and the amplifier 144 drive the speaker 72 under the control of the microcontroller 122.

The audio processor chip 120 further has built in speech recognition functionality for recognizing responses spoken into the microphone 118. Audio signals received through the microphone 118 are converted to electrical signals and sent to a preamp and gain control circuit 128. The preamp and gain control circuit 128 is controlled by an automatic gain control circuit 136, which is in turn controlled by the microcontroller 122. After being amplified by the preamp 128, the electrical signals enter the chip 120 and pass through a multiplexer 130 and an analog to digital converter (ADC) 132. The resulting digital signals pass through a digital logic circuit 1.34 and enter microcontroller 122 for speech recognition.

The audio processor chip 120 also includes a RAM 138 for short-term memory storage and a ROM 140, which stores programs executed by the microcontroller 122 to perform speech recognition and speech synthesis. The chip 120 operates at a clock speed determined by a crystal 126. The chip 120 also includes a clock 84 that provides the current date and time to the microcontroller 122. As in the preferred embodiment, the apparatus 27 includes an LED 74, display driver 82, modem 86, and device interface 90, all of which are connected to the microcontroller 122.

The operation of the second embodiment is similar to the operation of the preferred embodiment except that queries, response choices, and prompts are audibly communicated to the patient through the speaker 72 rather than being displayed to the patient on the display 64. The operation of the second embodiment also differs from the operation of the preferred embodiment in that responses to the queries and prompts are received through the microphone 118 rather than through user input buttons.

The script programs of the second embodiment are similar to the script program shown in FIGS. 6A–6B, except that each display command is replaced by a speech synthesis command and each input command is replaced by a speech recognition command. The speech synthesis commands are executed by the microcontroller 122 to synthesize the queries, response choices, and prompts through speaker 72. The speech recognition commands are executed by the microcontroller 122 to recognize responses spoken into microphone 118.

For example, to ask the patient how he or she feels and record a response, the microcontroller 122 first executes a speech synthesis command to synthesize through the speaker 72 "How do you feel? Please answer with one of the following responses: very bad, bad, good, or very good." Next, the microcontroller 122 executes a speech recognition command to recognize the response spoken into the micro-

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phone **118**. The recognized response is stored in the memory **80** and subsequently transmitted to the server. Other than the differences described, the operation and advantages of the second embodiment are the same as the operation and advantages of the preferred embodiment described above.

Although the first and second embodiments focus on querying individuals and collecting responses to the queries, the system of the invention is not limited to querying applications. The system may also be used simply to communicate messages to the individuals. FIGS. **16–19** illustrate a third embodiment in which the system is used to perform this automated messaging function. In the third embodiment, each script program contains a set of statements to be communicated to an individual rather than a set of queries to be answered by the individual. Of course, it will be apparent to one skilled in the art that the script programs may optionally include both queries and statements.

The third embodiment also shows how the queries and statements may be customized to each individual by merging personal data with the script programs, much like a standard mail merge application. As mentioned above, the individual may be identified for selection of individualized information either through an individual identification code associated with the remote apparatus **26** and stored in memory **80**. Referring to FIG. **16**, personal data relating to each individual is preferably stored in the look-up table **46** of the database **38**. By way of example, the data may include each individual's name, the name of each individual's physician, test results, appointment dates, or any other desired data. As in the preferred embodiment, the database **38** also stores generic script programs **40** created by the script generator **50**.

The server **18** includes a data merge program **55** for merging the data stored in table **46** with generic script programs **40**. The data merge program **55** is designed to retrieve selected data from table **46** and to insert the data into statements in generic script programs **40**, thus creating custom script programs **41**. Each custom script program **41** contains statements that are customized to an individual. For example, the statements may be customized with the individual's name, test results, etc. Examples of such customized statements are shown in FIGS. **17–18**.

The operation of the third embodiment is similar to the operation of the preferred embodiment except that the script programs are used to communicate messages to the individuals rather than to query the individuals. Each message is preferably a set of statements. Referring to FIG. **19**, the statements may be entered in the server **18** through the script entry screen **56**, just like the queries of the preferred embodiment.

Each statement preferably includes one or more insert commands specifying data from table **46** to be inserted into the statement. The insert commands instruct the data merge program **55** to retrieve the specified data from the database **38** and to insert the data into the statement. For example, the insert commands shown in FIG. **19** instruct the data merge program **55** to insert a physician name, an appointment date, a patient name, and a test result into the statements. As in the preferred embodiment, each statement may also include one or more response choices, which are entered in fields **96**.

Following entry of the statements and response choices, CREATE SCRIPT button **102** is pressed. When the button **102** is pressed, the script generator **50** generates a generic script program from the information entered in the screen **56**. The generic script program is similar to the script program shown in FIGS. **6A–6B**, except that the display commands specify statements to be displayed rather than

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queries. Further, the statements include insert commands specifying data to be inserted into the script program. As in the preferred embodiment, multiple script programs are preferably generated, e.g. a generic script program for diabetes patients, a generic script program for asthma patients, etc. The generic script programs are stored in the database **38**.

Following generation of the generic script programs, the server **18** receives script assignment information entered through the script assignment screen **57**. As shown in FIG. **7**, the script programs are assigned by first selecting one of the generic script programs through the check boxes **106**, selecting individuals through the check boxes **108**, and pressing the ASSIGN SCRIPT button **112**. When the button **112** is pressed, the data merge program **55** creates a custom script program **41** for each individual selected in check boxes **108**.

Each custom script program **41** is preferably created by using the selected generic script program as a template. For each individual selected, the data merge program **55** retrieves from the database **38** the data specified in the insert commands. Next, the data merge program **55** inserts the data into the appropriate statements in the generic script program **40** to create a custom script program **41** for the individual. Each custom script program **41** is stored in the database **38**.

As each custom script program **41** is generated for an individual, the script assignor **52** assigns the script program **41** to the individual. This is preferably accomplished by creating a pointer to the custom script program and storing the pointer with the individual's unique identification code in the table **46**. When the individual's remotely programmable apparatus connects to the server **18**, the server **18** receives from the remotely programmable apparatus **26** the individual's unique identification code. The server **18** uses the unique identification code to retrieve from the table **46** the pointer to the custom script program assigned to the individual. Next, the server **18** retrieves the assigned script program from the database **38** and transmits the script program to the individual's remotely programmable apparatus **26** through the communication network **24**.

The apparatus receives and executes the script program. The execution of the script program is similar to the execution described in the preferred embodiment, except that statements are displayed to the individual rather than queries. FIGS. **17–18** illustrate two sample statements as they appear on the display **64**. Each statement includes a response choice, preferably an acknowledgment such as "OK". After reading a statement, the individual presses the button **70A–D** corresponding to the response choice to proceed to the next statement. Alternatively, the script program may specify a period of time that each statement is to be displayed before proceeding to the next statement. The remaining operation of the third embodiment is analogous to the operation of the preferred embodiment described above.

Although it is presently preferred to generate a custom script program **41** for each individual as soon as script assignment information is received for the individual, it is also possible to wait until the individual's apparatus **26** connects to the server **18** before generating the custom script program **41**. This is accomplished by creating and storing a pointer to the generic script program **40** assigned to the individual, as previously described in the preferred embodiment. When the individual's apparatus **26** connects to the server **18**, the data merge program **55** creates a custom script program **41** for the individual from the generic script pro-

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gram 40 assigned to the individual. The custom script program 41 is then sent to the individual's apparatus 26 for execution.

Alternate Embodiments

In an alternate embodiment, when the user or patient (the terms user and patient are used interactively) activates the user input button 70E (hereinafter the red button) a command signal is sent to the processor 76. The processor 76 dial a preset phone number according to the command signal. The preset phone number is that of an answering service at the server 18 or at a workstation 20. The answering service identifies the patient or user associated with the remote apparatus 26 that generated the call based on an identifier sent with the call and user information stored in memory in the database (similar to caller ID). The system (server 18 or workstation 20) that receives the call then retrieves patient information with previous patient/user responses stored at the server's database 38, within memory at the workstation 20, or at some other remotely located storage site. The retrieved patient information is displayed to a live person who is in telephonic communication with the patient. This allows the patient to be placed in immediate contact with a person who has displayed before them the patient's personal health information or other patient historical information. The person receiving the call provides effective communication with the patient, because of the ability to view pertinent information.

In an alternate embodiment, an automated answering service is the recipient of the call made by the remote apparatus 26. The automated answering service asks a series of questions according to the retrieved patient information in order to triage the patient toward different actions depending upon the situation. The patient information also includes previous patient interactions with the automated answering service.

The system receiving the call process patient responses according to the content associated with the question asked. Content is one of the following categories: symptoms; behavior; knowledge. The categories include such things as requests for service or product orders. In one example, the automated answering service asks "do you have difficulty breathing? press the red button if you are." If the patient then presses the red button, the call is forwarded to a case manager or a nurse on call.

In another example, red button selection is associated with a request for service. When the red button is pressed, the automated answering service asks "do you need someone to change your bed? press the red button if yes." If the patient presses the red button, a home care agency coordinating ancillary daily activity services is notified or is forwarded the call. Other service companies, such as transport companies or concierge service companies, are other possible recipients of forwarded calls depending what actions are available to the patients.

The automated answering service is dynamically adaptable based on previous interactions with the automated answering service. For example, the past couple of times the patient activated the red button and answered the question(s), the patient was connected to an emergency health care worker. If the worker determined through review questions of the patient's present condition, maybe information generated by the monitoring device sent over the network 24 to a workstation operated by the worker, and retrieved patient information that no emergency existed, the worker records this situation into the patient's records. If the patient's record includes a number of false alarms that

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exceed a predetermined limit over a period of time, the automated answering service reprograms itself so that the next time the patient activates the red button the patient is directly connected to a live person that is designated for non-emergency patient interaction or to other questions that direct the patient to the person designated for non-emergency patient interaction. This frees-up emergency health-care workers from dealing with someone who has a history of not needing their expertise.

FIGS. 20 and 21 illustrate alternate embodiments of the invention illustrated in FIG. 1. In FIG. 20, the remote apparatus 26 is a personal computer including a processor and a user interface, e.g. display, keyboard, mouse, or other input and output devices (not all shown), that receives the script program, processes the script program and presents the script program for user interaction. For example, the script program requires that the personal computer present an image of a stand-alone remote apparatus 350, such as the Health Buddy™ produced by Health Hero Network, Inc., on the display. The user then interacts with the displayed image of the stand-alone remote apparatus by operating the user interface(s) of the personal computer to select displayed responses. The displayed image of the stand-alone remote apparatus presents a virtual image with the same functionality as the apparatuses 26 and 27, as described above in FIGS. 3 and 13. It can be appreciated to those of ordinary skill in the art that the system of FIG. 20 provides all or part of the functionality of the apparatuses shown in FIGS. 3 and 13, but does it on a personal computer.

FIG. 21 includes all the components of the FIG. 1 and a digital television network 36 in communication with the server 18 and the remote apparatus 26. The remote apparatus 26 of FIG. 21 is an interactive television system that includes a processing unit 33, such as a satellite broadcast receiving, set-top processor with OpenTV signal processing software, a display 34, such as a television set, and a user interface 35, such as a remote control. The remote apparatus 26, through the processing unit 33, is coupled to the communication network 24, the digital television network 36 and the monitoring device 28.

The processing unit 33 includes a CPU, memory and embedded software for receiving and processing both digital entertainment and advertisement content and digital script programs. Also, the processing unit 33 allows the user to view the entertainment and advertisement content, such as television programming, and interact with (i.e. respond to) the script programs. The script program(s) sent from the server 18 are viewable on the display 34 as they would appear on the display 64 of apparatus 26 or are viewed on a portion of the display 34. For example, the question with options shown in FIG. 8 would appear on the display 34. The user makes a selection of one of the choices by using the user interface 35, i.e. giving voice commands that are processed by a voice recognition system, controlling and activating a cursor, etc. Example methods of making a selection are to control a cursor icon on the display screen of the display 34 and activate the cursor icon when it is co-located with one of the choices, to assign different keyboard keys are designated as a different one of the displayed choices. Another method is to have the user interface include voice actuation software for processing user voice commands that request selection of a desired choice.

With respect to this invention, a "broadcast" includes any form of delivering the content from a source to many viewers, including transmission over the airwaves or via cable, the Internet, a closed-circuit network, or other means of communication. A "broadcast" does not require multiple

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persons to watch at once, but rather can include multiple individual and independent viewings, such as in the form of video on demand or access to web pages. Moreover, the term “broadcast” may include a single tailored transmission from a source to a single intended viewer. Accordingly, while a “broadcast” may include a transmission from one point to multiple recipients, it is not limited to that case. Likewise, with respect to this invention, a “broadcast” is “transmitted” in any of the above forms.

The processing unit 33 is a multimedia processor that receives transmitted broadcast programs from a digital broadcast network 36 via a communication link, such as a satellite or cable link. The processing unit 33 also transmits as well as receives data via the communication network 24. In addition, the multimedia processor has expansion ports to support additional user interface and other devices, such as keyboards, joysticks, trackballs, and to accept add-on circuits for enhanced sound, video, or processing performance.

FIG. 22 is an example for illustrative purposes only of a method for increasing user use of script programs by allowing the user to quickly access the script program during viewing of an entertainment or advertisement program in an interactive TV system. FIG. 22 illustrates a process performed by the system shown in FIG. 21. At block 400, the server 18 generates an interactive script program. In an alternate embodiment, the script program is fully or partially created at another remotely coupled computer, such as workstation 20, and added to multimedia content, then the script program and multimedia content is sent to the server 18. In one embodiment, the script program is specialized for a specific user according to a health care professional request or to a predefined health regimen based on user profile information. In an alternate embodiment the script program is generated, in relation to entertainment or advertisement content that it will later be broadcasted with. Next, at block 402, the generated script program is combined with digital produced entertainment or advertisement content, i.e. a multimedia presentation, to create digital broadcast programming. The digital broadcast programming is then broadcasted or transmitted over the chosen communication link, block 406. At block 408, the processing unit 33 receives and processes the digital broadcast programming then presents the entertainment or advertisement content and the script program. The processing unit 33 as directed by software instructions previously imbedded in the processing unit 33, included with the digital broadcast programming or a combination of both processes the digital broadcast programming by determining its content and how that content is to be presented on the display 34. For example, the processing unit 33 determines if the script program is to be referenced by an icon over the entertainment content or displayed on a portion of the display with the entertainment content. As part of the presentation from block 408 the user is informed of any script program included in the broadcast programming, block 410. Then, at block 426, the user is presented with the script program after the user selects or activates the indication, e.g. an icon. Lastly, at block 428, the user interacts with the script program by responding to any queries and inputting any requested measurements or other responses. The interaction with the script program is similar to that described above for the system of FIG. 1. In another embodiment, the script program is presented in conjunction with the entertainment or advertisement content without requiring the user to select or activate an indicator.

FIGS. 23 and 24 are example images presented on the displays 34 in the system illustrated in FIG. 22. FIG. 23 illustrates a screen shot of a broadcast program 250 that

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includes entertainment content 252, such as a video program on heart surgery, and an icon 254. The icon 254 indicates that a script program is available for the viewer. In order for the viewer to access the script program, the viewer selects the icon 254. The program broadcasted from the broadcast network 24 may have included an entire script program or just a portion of a script program. If the entire script program were included with the broadcast, selection of the icon 254 would begin execution of the script program that was received. However, if only a portion of the script program was received and, for example, that portion only required that the icon 254 be displayed with the entertainment content 252, selection of the icon 254 sends a signal through a back channel, i.e. the link to the communication network 24, to the server 18. The sent signal is a request for the rest of or just more of the script program to be sent to the apparatus 26 either is through broadcast network 36 or communication network 24.

FIG. 23 illustrates a screen shot of a broadcast program 250 that includes entertainment content 252 and a section that presents a script program image 256. In this example the viewer can interact with the script program image 256 while simultaneously viewing the entertainment content 252. As in FIG. 22 above, the script program may be fully or partially received and processed by the processing unit 33. And again, if it has only been partially received, viewer interaction at a predetermined spot in the displayed interaction process automatically initiates a request through the back channel to the server 18 for the rest of the script program.

Because the broadcast program 250 is a digital broadcast, it can be readily appreciated by those of ordinary skill in the art of digital interactive television, that the entertainment content may be paused until viewer completion of the script program. The script program which can be sent with an initial broadcast program or during presentation of a previously delivered broadcast program that is being presented on the display may also include instructions to pause the entertainment content until viewer completion of the script program at which time the entertainment program resumes. For example, the viewer’s/patient’s doctor creates a message at the workstation 20 requesting that the patient as soon as possible send blood pressure measurement readings. This message is generated as a new script program at the server 18. The server 18 then sends the new script program to the broadcast network 36. The broadcast network 36 includes hardware and/or software mechanisms for saving the new script program for inclusion with the next patient requested entertainment or advertisement content to be sent to the patient in the case where the patient is not presently viewing a broadcast from the broadcast network 36 or for just broadcasting the script program alone. If the patient is presently viewing entertainment or advertisement content received from the broadcast network 36, the new script program is received, processed and presented to the patient by the apparatus 26. The received new script program may include instructions to pause the presently viewed entertainment or advertisement content.

If the script program is specified for a particular patient, the server 18 or broadcast network 36 encodes the script program for that patient. The apparatus of that patient includes a decoding component within the processing unit 33 for decoding the encoded script program received with the broadcast program. For example, the script program includes a weight history chart of the patient. The present invention wants only the patient corresponding to this weight history chart to have viewing access. Therefore, it is

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encoded for transmission and encoded only by the corresponding patient's apparatus **26**.

It can be appreciated to one of ordinary skill in the art that this decision, as with the other flow diagram decisions, can be an inherent decision in the processing of the received entertainment/advertisement programming and script program.

The embodiments of FIGS. **20** and **21** may also be implemented without any entertainment or advertisement content and perform the functions as to those that illustrated and described for FIG. **1**.

The script programs or entertainment/advertisement programming can be designed for education and training of users. For example, the script program or information content could show a user, such as a patient, how to effectively use a medical treatment device. Also, the script program or information content could describe to users, such as doctors, nurses or anyone other professional, different treatment styles, plans or new medication.

A wide variety of information may be collected, delivered and analyzed in accordance with the present invention. For example, abandoned U.S. patent application Ser. No. 09/378,188 which is a continuation of U.S. Pat. No. 5,985,559, which is a continuation of U.S. patent application Ser. No. 09/041,809 (the text of which are hereby incorporated by reference) discusses information related to disease causes, treatments, and cures. Script programs include a set of queries for requesting data on lifestyle, environment, behavior, drug compliance, drug response over time, and other aspects. This data is then analyzed to identify trends and establish subgroups with similar responses.

Individuals' behavioral and environmental information in conjunction with their gene sequence information is analyzed to find drug candidates and drug targets. Individuals previously designated as having a high risk for developing a particular disease are each given an apparatus **26**. Queries related to the individuals' behavior and environment are included in a script program sent from a server **18** to the apparatus **26** or from a server **18** to the apparatus **26** through a broadcast network **36**. The individuals' responses are sent back to the server **18**. The process of collecting individuals' information can take place over a long period of time to ensure accurate data and to allow researchers to observe progression of the disease. A data mining program on the server analyzes the individuals' behavioral and environmental information, as well as their gene sequence information. Differences in gene sequence information, or in behavioral and environmental factors between individuals who show a severe disease phenotype and those who show a mild severe disease phenotype can then be distinguished and used to develop new drug candidates, targets, or general treatments.

Genetic testing allows an individual to determine whether or not he or she has a predisposition to a certain disease. The degree of expressivity of a certain disease will be determined in part by an individual's environment and lifestyle. The environment and lifestyle information is retrieved from responses to queries sent from the server **18** to the apparatus **26** or from the server **18** to the apparatus **26** through the broadcast network **36**. The present invention interprets a patient's gene sequence information and his or her environment and lifestyle to come up with a personalized prognosis. This procedure can be repeated many times over the course of a disease state to monitor a patient's condition. In addition, disease-causing pathogens can also have their genes sequenced. Using these sequences in combination with information about a patient's environment and lifestyle, the present invention comes up with a personalized treat-

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ment plan, ideally to eliminate the pathogen. It is also possible to use the procedure described above to monitor the course of the disease-state produced by a pathogen. Finally, a genotype-to-phenotype map or database can be constructed for developing better treatments and aiding in research.

Although the above description contains many specificities, these should not be construed as limitations on the scope of the invention but merely as illustrations of some of the presently preferred embodiments. Many other embodiments of the invention are possible. For example, the scripting language and script commands shown are representative of the preferred embodiment. It will be apparent to one skilled in the art many other scripting languages and specific script commands may be used to implement the invention.

Moreover, the invention is not limited to the specific applications described. The system and method of the invention have many other applications both inside and outside the healthcare industry. For example, pharmaceutical manufacturers may apply the system in the clinical development and post marketing surveillance of new drugs, using the system as an interactive, on-line monitoring tool for collecting data on the efficacy, side effects, and quality of life impact of the drugs. Compared to the current use of labor-intensive patient interviews, the system provides a fast, flexible, and cost effective alternative for monitoring the use and effects of the drugs.

The system may also be used by home healthcare companies to enhance the service levels provided to customers, e.g. panic systems, sleep surveillance, specific monitoring of disease conditions, etc. Alternatively, the system may be used to monitor and optimize the inventory of home-stationed health supplies. As an example, the system may be connected to an appropriate measuring device to optimize timing of oxygen tank delivery to patients with chronic obstructive pulmonary disease (COPD).

The system and method of the invention also have many applications outside the healthcare industry. For example, the system may be used for remote education over the Internet, facilitating educational communication with children or adult trainees who lack access to sophisticated and expensive computer equipment. The system may also be used by law enforcement officers to perform on-line surveillance of individuals on probation or parole.

In an alternate embodiment, the software and hardware components of any one of the remote apparatuses **26** or **27** are incorporated directly into a monitoring device. This allows a patient to only have to interact with one device for their entire health monitoring needs.

Further, the invention has numerous applications for gathering data from remotely located devices. For example, the system may be used to collect data from smart appliances, such as identification check systems. Examples of appliances that are used as smart appliances are refrigerator, telephone, stove, clock radio, VCR, or any other electrical or non-electrical device including the monitoring device **28**. The smart appliance includes some or all of the components of the remote apparatuses **26** or **27** as illustrated in FIGS. **4** and **15**. The smart appliance with the necessary hardware or software components provides all the interactive capabilities described and shown for remote apparatuses **26** or **27**, see FIGS. **8-12**, **14**, **17** and **18**. In one embodiment, the assigned scripts are in the form of a recorded voice that is sent over the communication network (e.g. voice over IP) to the appliance or remote apparatus. Also, the user responds to the voice scripts through activation of buttons according to

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instructions in the voice scripts or by verbally responding to the voice scripts. The verbal responses by the user are sent to the server or workstation over the communication network (e.g. voice over IP). The server or workstation includes a voice recognition component for interpreting the user's verbal responses, records the response and determines the next question or request (verbal or otherwise) to be sent to the user according to the responses. Live voice communication is also possible between the remote apparatus and the server or workstation over the communication network.

Also, the monitoring device includes a communication component for allowing the monitoring device to send data directly to the server 18. The server 18 then sends the monitoring device data to the patient's smart appliance for display to the patient. In an alternate additional setup, the monitoring device sends the data to the smart apparatus.

Alternatively, the system may be applied to the remote monitoring of facilities, including safety and security monitoring, or to environmental monitoring, including pollution control and pipeline monitoring. Many other suitable applications of the invention will be apparent to one skilled in the art.

Therefore, the scope of the invention should be determined not by the examples given, but by the appended claims and their legal equivalents.

The invention claimed is:

1. An apparatus for providing a healthcare professional with health-related information about an individual, the apparatus comprising:

a processor for executing a program received from at least one remote server via a first communication link through a communication network connecting the apparatus and the at least one remote server, wherein the program, when executed by the processor, causes the apparatus to present one or more health condition related queries to the individual;

a memory that stores the program received from the at least one remote server; and

a user interface through which the individual can input one or more responses to the one or more health condition related queries, wherein the apparatus (i) stores the one or more responses and (ii) transmits the one or more responses together to the at least one remote server after establishing a second communication link through the communication network.

2. The apparatus of claim 1, wherein executing the program further causes the apparatus to present one or more response choices in connection with at least one of the one or more health condition related queries.

3. The apparatus of claim 1, wherein the apparatus further includes a display for use in displaying the one or more queries to the individual.

4. The apparatus of claim 1, wherein the user interface has one or more user input buttons.

5. The apparatus of claim 1, wherein the user interface has a touch-sensitive display screen.

6. The apparatus of claim 1, wherein the individual is a patient and the received program is assigned to the individual.

7. The apparatus of claim 1, wherein the received program is generated based on information entered by a healthcare provider.

8. The apparatus of claim 1, wherein the one or more responses are stored in the memory prior to transmission to the server.

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9. The apparatus of claim 1, further comprising an audio transducer that audibly notifies the individual when unanswered queries exist.

10. The apparatus of claim 1, further comprising a visual indicator that visually notifies the individual when unanswered queries exist.

11. The apparatus of claim 1, wherein one or more monitoring devices are connected to the apparatus.

12. The system of claim 11, wherein execution of the program prompts the individual to connect at least one monitoring device to the apparatus.

13. The system of claim 11, wherein execution of the program enables collection of measurements from at least one monitoring device.

14. The apparatus of claim 11, wherein the one or more monitoring devices comprise a device, multiple devices or a combination of devices selected from the group consisting of a sensor for measuring a blood-related physiological condition, a sensor for measuring a respiratory function, a sensor for measuring respiratory flow, a sensor for measuring a weight-related condition, a sensor for measuring a heart-related condition, a sensor for measuring blood pressure, a sensor for measuring electrical activity of the individual.

15. The apparatus of claim 11, wherein the one or more monitoring devices comprise a device, multiple devices or a combination of devices selected from the group consisting of blood pressure cuffs, weight scales, electronic weight scales, pulse rate monitors, heart rate monitors, respiratory flow meters, peak flow meters, blood glucose meters and electrocardiography (EKG) devices.

16. A method for collecting health-related information about an individual, comprising:

receiving a program transmitted from a remote server via a first communication link through a communication network;

executing the received program to cause presentation of one or more health condition related queries to the individual;

receiving from the individual, through a user interface, one or more responses to the one or more queries;

storing the one or more responses;

establishing a second communication link through the communication network with at least one remote server; and

transmitting data related to one or more of the responses to the at least one remote server via the second communication link through the communication network.

17. The method of claim 16, wherein executing the program provides one or more response choices in connection with at least one of the one or more queries.

18. The method of claim 16, wherein the queries are presented on a display.

19. The method of claim 16, wherein the responses are received through user input buttons.

20. The method of claim 16, wherein the responses are received through a touch-sensitive display screen.

21. The method of claim 16, wherein the program is generated by the server from which it is received.

22. The method of claim 16, wherein at least one of the queries presented to the user is based on a query entered into a remote workstation networked with the server.

23. The method of claim 22, wherein the individual is a patient and the program is assigned to the individual.

24. The method of claim 23, wherein the program is generated based on information entered by a healthcare provider.

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25. The method of claim 24, wherein the healthcare provider is the patient's physician.

26. The method of claim 16, further comprising storing the one or more responses prior to transmission to the server.

27. The method of claim 24, further comprising audibly notifying the individual when unanswered queries exist.

28. The method of claim 24, further comprising visually notifying the individual when unanswered queries exist.

29. The method of claim 16, further comprising connecting one or more monitoring devices to the apparatus.

30. The method of claim 29, wherein execution of the program prompts the individual to connect at least one monitoring device to the apparatus.

31. The method of claim 29, wherein execution of the program enables collection of measurements from at least one monitoring device.

32. The method of claim 29, further comprising using the one or more monitoring devices to collect patient health related measurements.

33. The method of claim 29, wherein the one or more monitoring devices comprise a device, multiple devices or a combination of devices selected from the group consisting of a sensor for measuring a blood-related physiological condition, a sensor for measuring a respiratory function, a sensor for measuring respiratory flow, a sensor for measuring a weight-related condition, a sensor for measuring a heart-related condition, a sensor for measuring blood pressure, a sensor for measuring electrical activity of the individual.

34. The method of claim 29, wherein the one or more monitoring devices comprise a device, multiple devices or a combination of devices selected from the group consisting of blood pressure cuffs, weight scales, electronic weight scales, pulse rate monitors, heart rate monitors, respiratory

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flow meters, peak flow meters, blood glucose meters and electrocardiography (EKG) devices.

35. The method of claim 16, wherein more than one individual is monitored.

36. The apparatus of claim 1, wherein said processor further comprises an interpreter configured to interpret commands in said program for execution by said processor.

37. The apparatus of claim 36, wherein said interpreter is included in firmware for controlling operation of the apparatus.

38. The method of claim 16, wherein said health-related information about said individual is provided to a healthcare professional.

39. An apparatus for providing a healthcare professional with health-related information about an individual, the apparatus comprising:

means for executing a program received from at least one remote server via a first communication link through a communication network connecting the apparatus and the at least one remote server, wherein the program, when executed, causes the apparatus to present one or more health condition related queries to the individual; means for storing the program received from the at least one remote server; and

means for interfacing through which the individual inputs one or more responses to the one or more health condition related queries, wherein the apparatus (i) stores the one or more responses and (ii) transmits the one or more responses together to the at least one remote server after establishing a second communication link through the communication network.

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