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(54) Interactive patient assistance system.

(57) A system is provided for interactively assisting a patient. The system includes a speech synthesizer and recognition unit coupled to a programmed computer. The computer can keep track of a medication and diagnostic testing schedule. The system also includes diagnostic testing equipment coupled to the computer along with medication dispensing equipment. In accordance with a predetermined schedule, the system verbally communicates with the patient, prompts the patient through the various steps necessary to carry out the diagnostic testing and further prompts patient at appropriate times for taking medication. The medication is also provided in combination with the verbal prompts. The system also provides access to a telecommunications link in response to verbal requests of the patient and in one embodiment can move in a limited area adjacent the patient.

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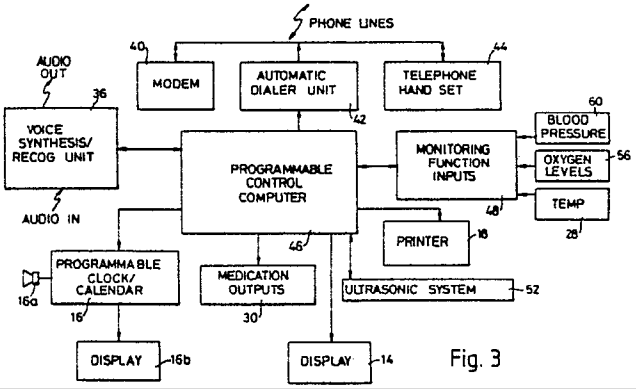

Fig. 3

MULTI-CONTAINER INTERACTIVE SYSTEM

Reference to Related Patent Application

The present patent application is a continuation-in-part of patent application Serial No. 194,018 filed May 12, 1988 entitled INDIVIDUAL ASSISTANCE SYSTEM and assigned to the same assignee as the present application.

Field of the Invention

The invention pertains to apparatus and devices for assisting individuals. More particularly, the invention pertains to a computer based system for providing at home or institutional assistance to a convalescing or injured patient.

Background of the Invention

Over the last several years, there has been a substantial shortening of the period of time patients remain in hospitals. Reductions in hospital stays are directly related to the Federal Medicare Regulations governing reimbursements to hospitals and other institutions. These regulations impose strict limits on the number of hospital days, or institution days, for which Medicare will reimburse the hospital or institution.

Due to the shortened hospital stays, many patients are returning home in a debilitated or partially recovered condition. These patients often need assistance or reminders that medication should be taken, or that various measurements such as temperature or blood pressure should be made.

This situation is exacerbated by the fact that the size of the population which is over 65 years of age is continually increasing and will be increasing for the foreseeable furture. In addition, because of the improved health care delivery system in general, patients with chronic diseases are surviving for longer periods of time and leading relatively normal lives with intermittent outpatient intervention.

It has also been recognized that patients who need follow-up or who are convalescing at home can benefit from regular home monitoring. Such monitoring provides follow up information concerning the condition of the patient.

For instance, home monitoring can provide information concerning the long-term effectiveness of drugs. This information can in turn lead to altering, increasing or decreasing prescription requirements to more cost effectively obtain the desired result with the patient.

Home monitoring can also provide long-term trend information concerning patient vital signs. In extreme cases, home monitoring can result in immediate intervention to avoid a life threatening situation.

Thus, there continues to be a need for devices and apparatus which would be of assistance to homebound patients in a variety of ways. Further, there continues to be a need for such devices which can be provided cost-effectively.

Summary of the Invention

In accordance with the invention, a patient assistance system is provided for repetitively interacting with an individual in need of assistance. The system can provide a variety of functions useful to an individual who may be debilitated or convalescing from an injury or an illness.

The system includes a control unit which can provide a variety of patient support functions. A programmable clock/calendar readout is coupled to the control unit. The clock/calendar unit can be programmed to perform reminder functions at predetermined times. For example, the clock/calendar unit can provide a wake-up alarm, can regulate medication dispensing, or can keep track of times at which tests should be carried out.

An audible alarm or visual indicator can be provided as a reminder of when an activity should be commenced. The audible alarm can also be used to introduce an audible synthesized message.

The system also includes voice synthesizer circuitry for the purpose of generating audible messages. The messages can remind the patient of specific, preprogrammed, tasks to be performed at predetermined times. For example, the voice synthesizer circuitry, in combination with the control unit, can remind the

patient that it is time to take medication or carry out a monitoring test such as taking a temperature or a blood pressure.

The voice synthesizer circuitry can also be used to communicate with the patient when the preprogrammed schedule needs to be varied. That circuitry can also prompt verbal responses usable to determine general patient condition.

Speech detection circuitry can be used to analyze those responses or requests. That circuitry can then signal the control unit with an identification of those responses.

The voice recognition and synthesis circuitry can be used to verify, via audio feedback from the patient that certain tasks have been successfully performed. These include taking medication or conducting various tests.

As an alternate, a keyboard could be used for operator input instead of voice recognition circuitry. Instead of a keyboard a touch-sensitive screen can be used.

The system can also include sound and motion detecting systems. The sound detection system, coupled to the control unit, can detect ultrasonic transmissions from a patient transmitter such as a medallion or a wrist transmitter. The sound detection system can also detect and enable the control system to respond to requests by the patient for assistance.

A moveable embodiment of the system includes an ultrasonic collision avoidance system. The ultrasonic system can determine distance, range and proximity of objects for collision avoidance purposes. Further, the ultrasonic system enables the patient assistance system to move within a specified region near the patient to provide for easy accessibility thereto.

The system can also include an interface between the control unit and a telephone. In response to commands from the control unit, the interface can provide for automatic dialing in response to patient requests or in response to detected emergency conditions.

The system also includes a printer for generating a hard copy record of daily medical information including test results as well as delivery of medication. A recording system can store that information in machine readable form.

A modem is coupled to the automatic dialer in the interface. The modem can be used for the purpose of communicating with a remote medical computer, for transferring patient information to the remote computer or for receiving programmed instructions or information from the remote computer.

Further in accordance with the invention, a method of interacting with a care requiring individual is provided. The method includes the steps of:

detecting audio emergency requests for help from the individual;

detecting when the individual should receive predetermined medication;

making the predetermined medications available to the individual in accordance with a predetermined schedule;

verifying that the predetermined medications have been received by the individual;

recording electronically the fact that the medications have been provided as well as the fact that an indicium has been received that the medications were received by the individual;

reminding the individual to carry out certain predetermined monitoring tests at predetermined time intervals;

recording electronically results of the predetermined tests;

automatically dialing a predetermined number to establish a communication link with a remote information receiving unit; and

transferring the results of the monitoring test step to the remote unit.

Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention and the embodiments thereof, from the claims and from the accompanying drawings in which the details of the invention are fully and completely disclosed as a part of this specification.

Brief Description of the Drawings

Figure 1 is a perspective view of a stationary recordkeeping and medication delivery interactive system in accordance with the present invention;

Figure 2 is a perspective view of a moveable recordkeeping and medication delivery interactive system in accordance with the present invention;

Figure 3 is a block diagram schematic of an electronic system in accordance with the present invention.

Figure 4 is an overall perspective view of a system in accordance with the present invention interacting with a patient;

Figure 5 is a fragmentary perspective view of the system of Figure 4 supported on a powered module for movement;

Figure 6 is a rear elevational view of the system of Figure 4;

Figure 7 is an enlarged fragmentary view in perspective of a portion of the thermometer storage/delivery unit;

Figure 8 is an enlarged fragmentary view in perspective of a portion of the product storage/delivery unit;

Figure 9 is an enlarged fragmentary view in perspective, partly broken away, of the actuating mechanism of the storage/delivery unit of Figure 7;

Figure 10a is a view in section illustrating a first or inactive state of the product dispensing mechanism;

Figure 10b is a view in section of the product dispensing mechanism in a second or dispensing state;

Figures 11a-11e, taken together, are a flow diagram of the software and interactions of the system of Figure 4;

Figure 12 is an overall block diagram schematic of the electronic control system of the system of Figure 4;

Figure 13 is a detailed electronic schematic of a portion of the interface circuitry of the system of Figure 4; and

Figures 14a and 14b, taken together, are a detailed electronic schematic of another portion of the interface circuitry of the system of Figure 4.

Detailed Description of the Preferred Embodiments

While this invention is susceptible of embodiment in many different forms, there are shown in the drawing and will be described herein in detail specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

Figure 1 is a perspective view of a patient assisting system 10 in accordance with the present invention. The system 10 includes a housing 12. carried by the housing 12 is a video display unit 14.

The system 10 includes a clock/calendar unit 16. The clock/calendar unit 16 can be a digital unit with an integrally formed display.

The housing 12 carries an audible alarm 16a. The audible alarm 16a can be actuated by the electronic clock/calendar unit 16. The clock/calendar unit can be a programmable unit in which a schedule can be established to identify a variety of scheduled activities during a 24-hour interval. A display 16b is also coupled to the clock/calendar unit 16.

The housing 12 also carries a hard copy printer 18 capable of generating hard copy 20. The copy 20 can include information pertaining to medication schedules, delivered medication, test results or instructions as may be desired.

The system 10 can also include a blood pressure monitoring cuff storeable in a region 24 of the system 10. The same cuff can be used for pulse rate detection as well.

The system 10 can also include a thermometer 28 coupled thereto. The thermometer 28 can be drawn from the system 10 and used by the patient to provide an indication of corporal body temperature. The thermometer 28, the blood pressure cuff and the pulse rate sensor can be used to provide feedback to the system 10 concerning patient related characteristics. Temperature and blood pressure measurement values can be displayed using readouts 29.

The system 10 also includes a pharmaceutical dispenser 30. The pharmaceutical dispenser 30 can under control of the system 10 dispense medication on a strip 32 in accordance with a schedule maintained by the programmable clock/calendar unit 16.

The medication on the strip 32 can be dispensed in combination with either a printed reminder which can be printed by the printer 18 on the strip 20 or in combination with a verbal reminder. A voice synthesizer and recognition unit 36 carried by the housing 12 can provide audio reminders to the patient that a scheduled time for taking a medication has arrived. The unit 36 can provide audible feedback from the patient to the syste 10.

For example, the voice synthesizer and recognition unit 36 can detect statements made by the patient requesting assistance. These statements can include requests for help if the patient is in need of outside

assistance. Alternately, the voice synthesizer and recognition unit 36 can detect requests by the patient to display information on the display 14 or to provide the appropriate medication. Finally, the voice synthesizer and recognition unit 36 can be used by the patient to establish the schedule to be maintained by the programmable clock/calendar unit 16.

It will be understood that in addition to detecting blood pressure, heart rate and body temperature, the system 10 could provide facilities for detecting blood gas levels as well as carrying out other types of non-invasive diagnostic tests. For example, one type of diagnostic testing that can be carried out in connection with the system 10 make use of known oximetry probes. Such probes can be attached to the ear lobe or finger of the patient and provide for continuous or intermittant reading of oxygen saturation levels in the blood.

The system 10 also incorporates a modem 40 which can be utilized in combination with an automatic dialer unit 42. The modem 40 could incorporate a standard type of telephone handset 44 if desired. By incorporating a handset 44, the system 10 can provide for a voice communication between the patient and a remote location.

By means of the modem 40, the system 10 can communicate with a remote medical center over the telephone system. Information which has been accummulated in the system 10 concerning patient activity or the results of diagnostic testing can be automatically transmitted via the modem 40 and the telephone system to a remote medical center computer for analysis. The results of such analysis can be used to determine whether or not further intervention, such as changing the medication schedule or the type of medication, is desirable.

The system 10 can also include a magnetic recording system. The recording system can record, on a relatively long-term basis, results of diagnostic tests, information concerning patient activity, dispensed medication and any other information of value in improving the quality of patient care.

The various elements of the system 10 function with a control unit 46. The control unit 46 could include a programmed computer.

Figure 2 illustrates a perspective view of an alternate embodiment 50 of the system 10. The system 50 includes many of the functions and capabilities previously described with respect to the system 10. Such elements are identified using the same identification numerals as were used with respect to the system 10.

In addition, the system 50 provides additional capabilities and functions not present in the system 10. The system 50 in contradistinction to the system 10 is moveable under the command of the internal programmed control computer 46. The moveability of system 50 permits it to move toward the bedside or chair of the patient for ease of interaction with the patient.

Control over the movement of the system 50 by the computer 46 is effected by an ultrasonic system 52. The ultrasonic system 52 includes both a transmitter and a receiver 52a and 52b respectively. The ultrasonic system 52 can detect transmission from a patient-carried transmitter. The patient-carried transmitter can be used to inform the system 50 of the location of the patient. It can also be used to detect whether or not the patient is ambulatory and whether or not the patient has had an accident and has fallen and is in need of additional assistance.

The ultrasonic system 52 can also determine distance, range and proximity to objects for the purpose of collision avoidance. The ultrasonic system 52 also permits the patient assisting system 50 to safely move within a specified range near the patient.

The system 50 also includes a nasal cannula 54 usable in connection with administering oxygen therapy. Further, the system 50 can also include a probe 56 for measuring saturated oxygen levels in the blood, as previously discussed. Such probes, such as 56, are noninvasive and can readily be affixed by the patient to the appropriate corporal member.

The system 50 also includes a digital blood pressure sensing cuff 60 which can be removed from the storage region 24. The patient can apply the cuff 60 to an arm or finger or any other appendage. Under control of the system 50, the cuff 60 can be automatically inflated, the results of the blood pressure measurement can be detected by means of the monitoring function input interface 48. The cuff 60 can then be deflated and removed by the patient for storage in the region 24.

Simultaneously with detecting blood pressure by means of the cuff 60, the patient's pulse rate can also be detected.

The system 50 includes the voice synthesis and recognition unit 36 which provides an audio communication and control path between the patient and the system 50. A battery 64 is carried within the housing 50a for the purpose of powering the unit 50. The battery 64 can be a rechargeable type which can be recharged during periods of patient inactivity, such as night.

If desired, the handset 44 can be of the cordless type. In this instance, the system 50 would also carry a transmission/reception antenna 66.

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