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Development of a Personal Medical Recorder on Cell Phone

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Abstract

Paper medical records have effectively been used in chronic diseases without information technology. To facilitate self-control in hemodialysis and observe a patient's condition continuously, we developed a mobile phone-based personal medical recorder for patients suffering chronic renal failure. The application is based on Java2 Micro Edition and operates like a scheduler. The application stores laboratory data, such as BP, BUN, creatinine, HbA1c, etc., and other pertinent clinical comments into memory on a cell phone. The application can also customize, add or delete items (laboratory data, medications, questions, etc.). Detailed graphic displays of the data are shown. The data can also be sent to a PC with infrared communications. In a usage trial, patients were favorably receptive about this application and indicated that they wanted to continue using it.

Keywords:

cell phone, medical records, infrared transmitter

Introduction

Using a notebook-type diary, a chronically ill person can get an overview of his or her medical situation [1]. Although patients with chronic renal failure can maintain an adequate nutritional intake, they might also be able to recognize their own pathophysiological state and be aware of the settings for their own hemodialysis. Although data collection was more reliable with a palmtop computer than with paper diaries [2], there have been no reports presenting a PDA/cell phone-based clinical recorder for chronic hemodialysis other than for dietary monitoring [3]. Therefore, we developed a cell phone-based medical recorder for self-management of chronic diseases.

Materials and methods

An application on a cell phone was designed as a self-control tool for patients who are familiar with cell phone applications such as games. The application is based on a scheduler consisting of 3 canvases, a calendar, data entry and a plot canvas, and memory control and infrared modules (Figure 1). The plot canvas shows colored lines of selected clinical and laboratory data, such as BP, BUN, creatinine, HbA1c, etc.

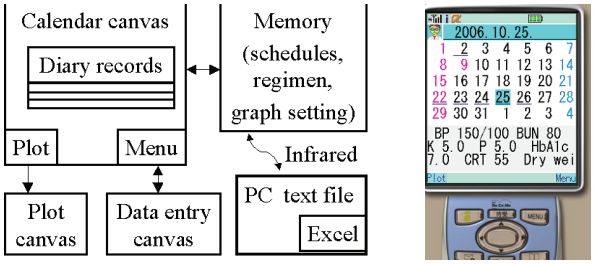

Figure 1 – An overview of the application and a calendar canvas

These data are stored in a textile format in the memory of the cell phone (maximum 200 kB). Because the record size of one schedule is estimated to be about 100 bytes, a maximum of 2000 records may be stored. An infrared module sends records in day or month units to a PC as a textile file. The records on the PC are automatically tabled and tallied on Excel with a customized VBA program.

The application was based on Java 2 Platform, Micro Edition (J2ME), and developed with an "i-appli Development Kit for DoJa-3.5" on a PC [4]. (The Doja is a version of the Java platform specially tailored to a mobile environment for NTT cell phones.) The application, a medical recorder (medData.jar 100kB), was uploaded with 2 files (medData.jam and medData.html) into our Web server. The application was then downloaded via the Internet and automatically installed into a Java-enabled cell phone in the usual way of a Java applet.

Results

For clarity, PC screens are shown in the regular order of usage rather than using photographs of cell phone screens (Figure 2). The application operates like a scheduler. Today, on the calendar, is highlighted in yellow. The selected day is highlighted in light blue and moved by operating the arrow keys. Each colored line on any day, e.g., 7th and 21st, corresponds to each clinical event or data and appears with comments and/or a graph in the lower area (Figure 2a).

Two records, pairs of the time of day and prescriptions (with laboratory data), are shown in this case (Figure 2b). Pushing the select key on a target record shows a data

entry canvas with laboratory item names and values. Numeric data are typed in by the patient. An adaptive submenu is automatically shown on the right side of the item along with a blood-flow setting for hemodialysis. All these values, including the time span, can later be edited.

Detailed graphic displays of data are sequentially shown on a plot canvas (Figure 2c). A trend graph of potassium for 1 year is shown in light blue (Figure 2d). The values in the last half of the year are higher than the target range shaded in the same color as the item in half tone. A horizontal scale of the graph is set to day, week, month or year by pushing 2, 5, 8 or 0, respectively. Graph properties of each item (vertical scale, normal range, line color, line mode and symbol) can be customized via a submenu on the calendar canvas (Figure 2e), e.g., a graph of BUN is shown in yellow bars (Figure 2f). In a selection canvas, plot items are marked with a black diamond (Figure 2g). A submenu of the calendar canvas includes functions: setting the system font, controlling infrared communications, customizing item/plot items, copying & pasting records, etc. (Figure 2h). Items (laboratory data, medications, prescriptions, questions, etc.) can be customized, added or deleted for each patient's disease.

The application was adapted for several patients in one trial. The patients were positive about this application and said that they would like to continue using it.

Discussion

Our application imposed upon the user to manually enter his or her own clinical data. The operation and graphics may deepen the patient's awareness of his or her symptoms, laboratory data, diseases, and prescriptions for self-managing therapies. The act of consciously entering and organizing data may be relevant to promoting desired behavior changes [5].

The application recognized only numeric keys where a numeric value should be entered: hour, minute, dosage, etc. Alphabetic characters are only used to enter comments. A menu is automatically shown when answers are ready. These functions do not allow any error messages that are objectionable when entering data to appear.

Graphs of clinical data are useful for awareness and self-management of chronic diseases. The system shows daily data and trend graphs of all plot items together on a calendar canvas and separately on a plot canvas. Arbitrarily selecting a horizontal term of the graph can be adapted to various data with a quick variation in minutes such as blood sugar and/or with a slow response in months for such items as glycosylated HbA1c. However, the system could be improved on the plot routines, since many daily records take about 1 second to make a graph of the data for each day of a month.

Conclusion

This personal medical recorder on a cell phone could be useful for patients requiring hemodialysis, since actively processing and managing data may improve their understanding and situational awareness. Our cell-phone application will record medical events at anytime and anywhere in a person's life.

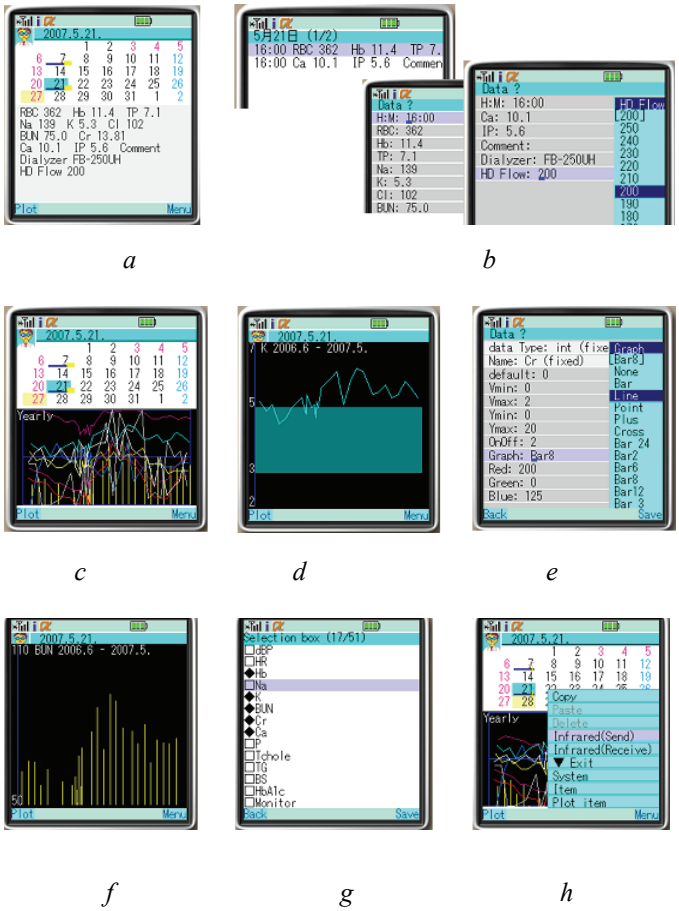

Figure 2 – Captured screen of (a) calendar canvas, (b) diary canvas and data entry canvas, (c) calendar canvas with a graph plot canvas, (d) plot canvas, (e) edit canvas to modify plot item properties, (f) a bar graph on the plot canvas, (g) selection canvas of plot items and (h) a submenu of the calendar canvas

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