Development of a personal medical recorder on a 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.

Introduction

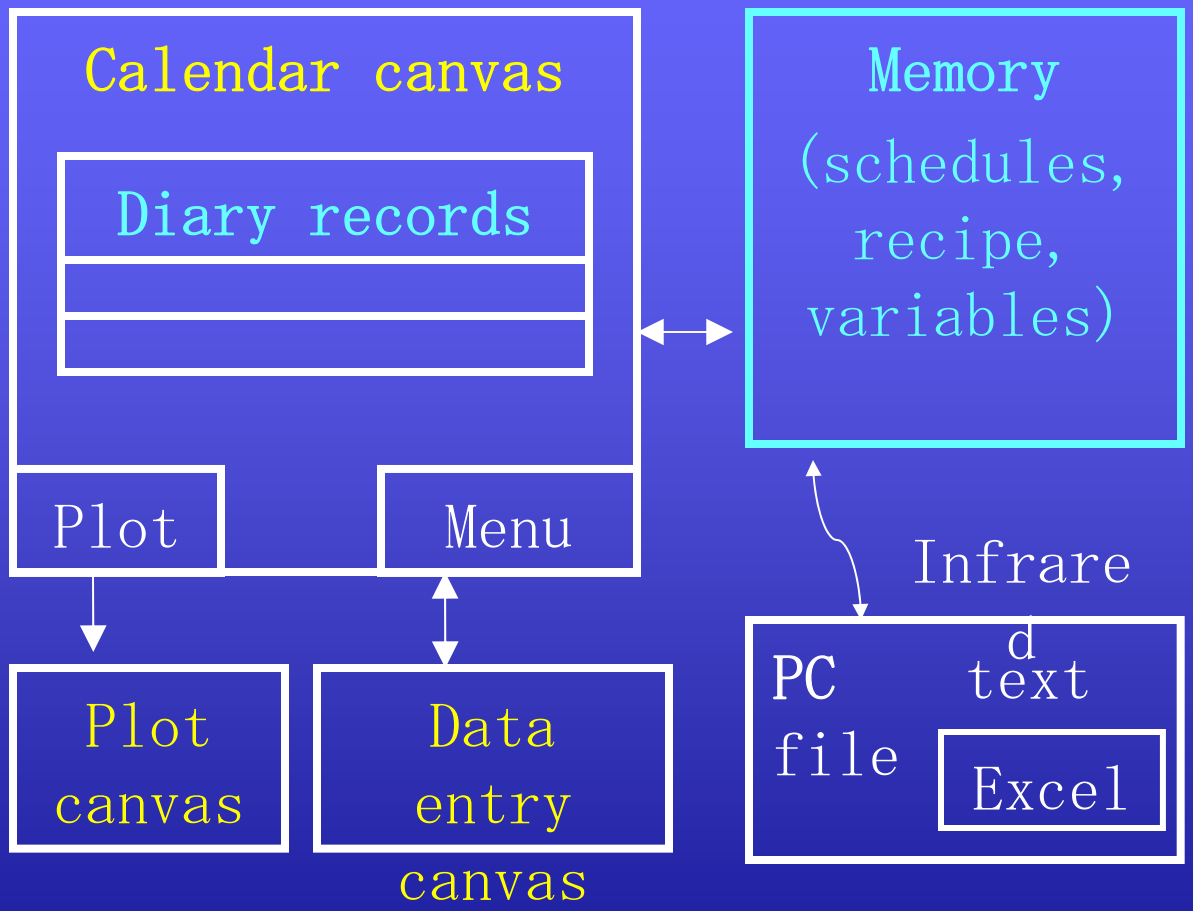
Using a notebook-type diary, a chronically ill person can get an overview of his or her medical situation [1]. Although patients with chronic renal failure can maintain an adequate daily nutritional intake, they might also be able to recognize their own pathophysiological state and be aware of the settings 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 (System design p5). The plot canvas shows colored lines of selected clinical and laboratory data, such as BP, BUN, creatinine, HbA1c, etc.

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.

System design



Software specifications

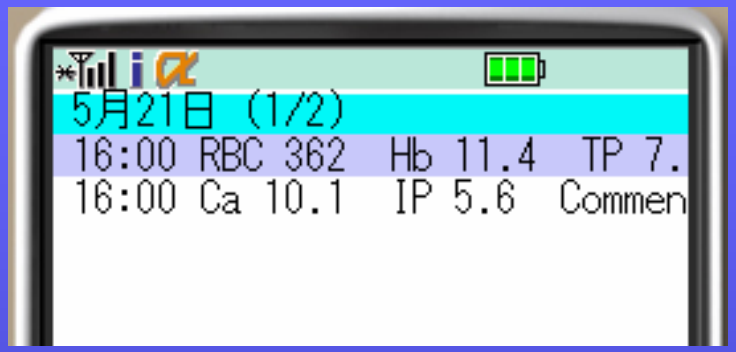
The application was based on Java 2 Platform, Micro Edition (J2ME), and developed with an "i-appli Development Kit for DoJa-3.5" on a PC [4]. (The Doja is a version of the Java platform specially tailored to a mobile environment of NTT cell phone.)

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.

Sample runs

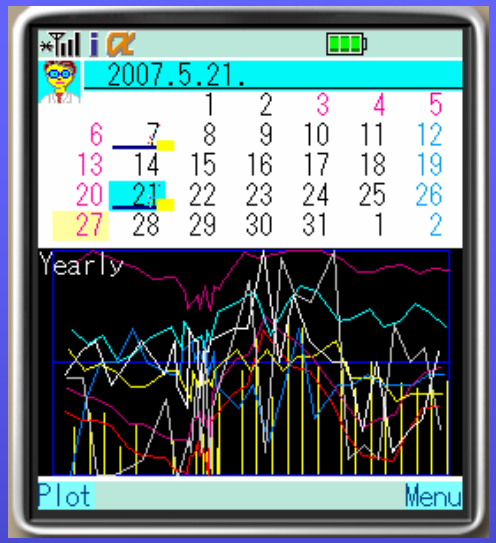
For clarity, PC screens are shown in the order of frequency of usage rather than using photographs of cell phone screens. The application operates like a scheduler. Today, on the calendar, is highlighted in yellow. The selected day is highlighted in light blue and moved by operating the arrow keys. Each 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.

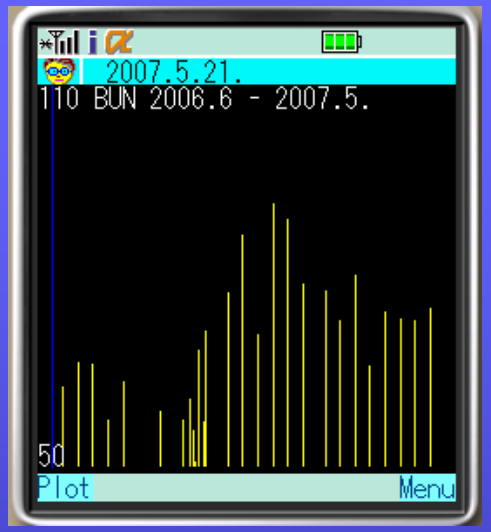
Entering/editing data



Two records, pairs of the time of day and prescriptions (with laboratory data), are shown in this case. 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 and a brief comment. All these values, including the time span, can later be edited.

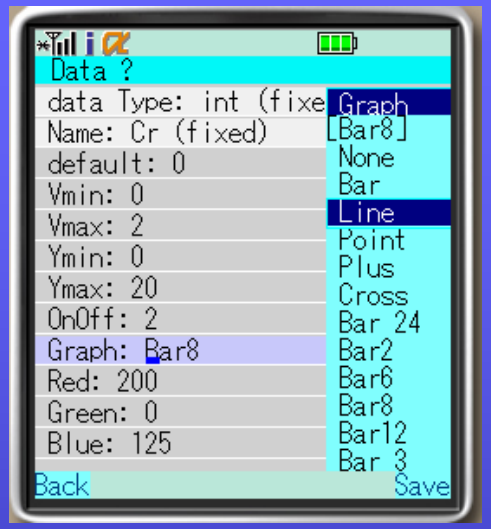
Graphics

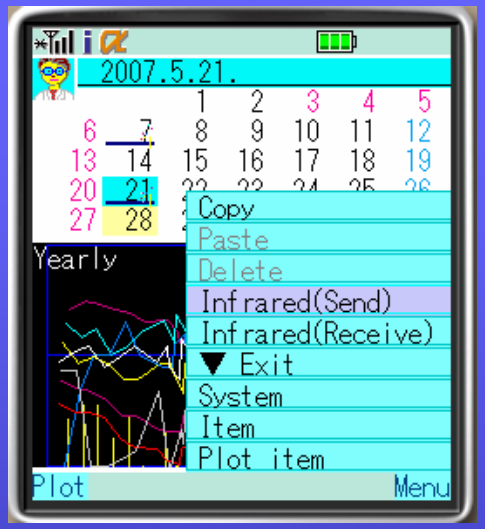




Detailed graphic displays of data are sequentially shown on a plot canvas (left). A trend gram of potassium for 1 year is shown in light blue (middle). The values in the last half of the year are higher than the target range shaded in the same color as the item in half tone. A horizontal scale of the graph is set to day, week, month or year by pushing 2, 5, 8 or 0, respectively.

Customizing





In a selection canvas, plot items are marked with a black diamond (left). Graph properties of each item can be customized via a submenu on the calendar canvas (middle), e.g., a graph of BUN is shown in yellow bars (Graphics p9, right). A submenu of the calendar canvas includes functions: setting the font, controlling infrared communications, customizing item/plot items, copying & pasting records, etc. (right). Items (laboratory data, medications, prescriptions, questions, etc.) can be customized, added or deleted for each patient's disease.

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 own symptoms, laboratory data, diseases, and prescriptions for self-managing therapies. "The act of consciously entering and organizing data may be just as relevant to promoting the desired behavior changes" [5].

The system draws daily data on each day, and trend graphs of all plot items together on a calendar canvas and separately on a plot canvas. Selecting arbitrarily a horizontal term of the graph can be adapted to various data with a quick variation in minutes such as blood sugar and with a slow response in months for such items as glycosylated HbA1c.

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.

References

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