Designing of an Embedded Software System for Patient's tele-Monitoring using SMS

Yousif. Ahmed , Zeinab. Abd Alrahman, Razan. Saad Aldeen, Elham. Altyeib, Khansaa Taha

Abstract-The research work of this paper provides Software for Monitoring Patient's medical data embedded into Mobile Phone to share this Information over a distance using GSM communication to be accessible for a central monitoring software system as forward step in embedded systems telemedicine applications.

This embedded software aimed to compos SMS contains the requested patient information's from suitable medical sensors using special commands and send this SMS to the central monitoring system according to the Doctor request. The central monitoring system parse received SMS and analyze the text to save and display the Patient Information's.

Keywords--Embedded, monitoring, telemedicine, mobile phone, windows mobile, open source, SMS

I. Introductions

IN general, Telemedicine can be defined as the delivery of health care and sharing of medical knowledge over a distance using telecommunication means. Telemedicine is widely considered to be part of the inevitable future of the modern practice of medicine. It is gaining more and more momentum as a new approach for patients' surveillance outside of hospitals (at home) to encourage public safety and to facilitate early diagnosis and treatment.

Telemedicine provides medical information exchange at a distance, to support medical procedure, with the ultimate goal for improving community health care. The aims of telemedicine is also to provide expert-based health care to understaffed remote side and to provide advanced emergency care through modern telecommunication and information technology. Information technology has been confirmed as an effective and efficient tool for delivering health services to widely distributed population.

It well be peter for patients who has periodic hospital visit to check is medical status such as blood pressure, cardiac, pregnant, diabetics and respiratory Patients and Patients live in rural area "far from hospital " don't have enough healthcare services to send the required follow up medical information from home.

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The pest implementation of the available telecommunication in such telemedicine applications can increases the health care level with regardless of patient and doctor Locations. The doctors will be updated at any time with the most recent patient's information.

Such projects can support a program for reducing Maternal Mortality Rate (MMR) and improving Mother and Child Health by providing continues mentoring..

II. Background

Embedded systems are widely used in medical applications and telemedicine.

First study: Mobile Messaging Services-Based Personal Electrocardiogram Monitoring System , this project describe telemedicine system based on mobile messaging services, namely, Short Messaging Service (SMS), which is an integral part of the original 2G GSM cellular system and subsequent generations, and Multimedia Messaging Service (MMS), which became available as part of the 2.5G cellular technologies and onward. This system transfers a patient's Electrocardiogram (ECG) signal and body temperature. The motivation of project to use mobile messaging services is that not only does it provide an alternative means of transmission in a cellular communication system but it is a more versatile and convenient option since all new phones are SMS and MMS capable. Additionally, under certain circumstances, SMS can be the only means of transmission in a cellular system. [1]

Second study: Mobile telemedicine application and technologies on GSM Using communication wireless technique and embedding system editing to provide People the media of long-distance caretaking. Contrasting with GPRS system especially strives for the combination of popularization, high using and covering rate, and lower fee needed for the patient who needs help ,to provide the method of diagnosis of blood pressure measurement and include emergency. This research divides into two parts , first one is Telecare , the other is Tele-emergency . In the first part the data is acquired from wrist able ,in the second part when the data exported by the motion sensor is fixed for a period of time, the microcontroller becames emergency mode. [2]

III. The method

Connecting the programmable phone of patient with the center point (doctor pc) through a distance can be divided in

to subtasks: Patient unit, Doctor Unit and communication unit design as in Figure(1)

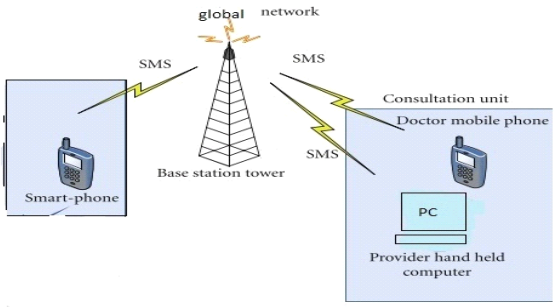

Fig.1 System plan

The patient unit function is: read the medical sensors, wait for center unit request, decompose the request and compos SMS with required data if request, send emergency SMS if emergence status fond. As in figure 2.

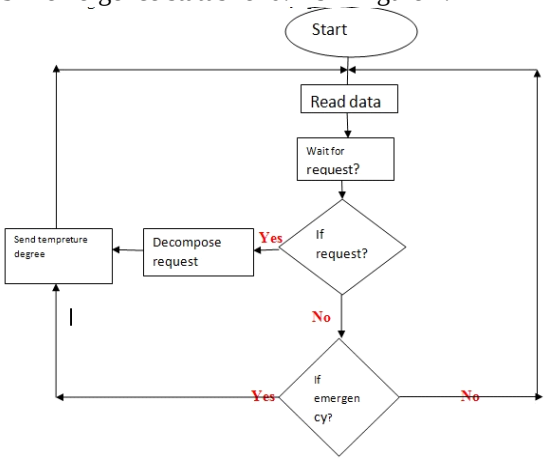

Fig. 2 The patient unit flowchart

The communication unit function in is to connect the patient and doctor units through distance using global systems for mobile communication (GSM)[3]. To complete this part, special purpose end to end communication protocol based SMS is used. This protocol contains some shared commands between HTC mobile phone and center pc. The command RTP "as example" patient temperature request in the format : RTP+<temperature>+<date>.

When the patient unit receives this command and parse , It will read temperature from temperature sensor, read the Date/time of message (day,month,year,hour,minut,second) then compos and send SMS in the same format to the senter unit : *for example send RTP+34+09122012012313.*

The center unit's function is: send the request for one or more medical information to the patient unit with a certain period according to doctor request, receive SMS message from the patient , extracts and save the contents to a file or immediately view in case of emergency as in Figure 3. Suitable user interface is required on the doctor PC for doctor to set patients phone numbers, the medical information required and its period and see patient(s) report(s) from saved file.

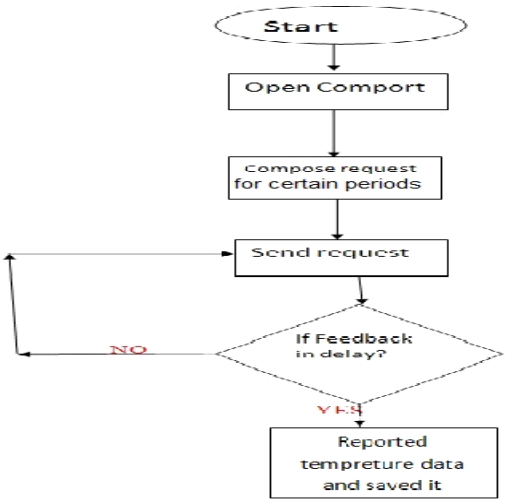

Fig. 3 The central unit flowchart

Several tools like HTC Mobile device, visual basic Programming language for HTC mobile with the outlook library to able it ability to receive data from sensor simulation and create SMS message to send it to the doctor when request, Windows Mobile 6 Professional SDK,.NET Compact Framework 3.5 and Windows Mobile Device Center used for the patient in addition to personal computer (Laptop) with GSM modem for the central unit

IV. Design and Result

HTC Touch 2 mobile phone supported with windows mobile phone version 6.5 operating system, Mobile office is greatly improved and. occasional use of WiFi, calls and applications as in figure 4 is used for patient unit because of its ability add and execute visual basic 2008 .NET projects required for compos, send and receive SMS automatically.

Fig. 4 HTC Touch 2 mobile phone

Visual basic programming language is supported with related libraries used to build applications for Windows Mobile 6" , Microsoft .NET Compact Framework3.5 (.NET CF) "a version of the .NET Framework that is designed to run on resource constrained mobile/embedded devices such as personal digital assistants (PDAs), mobile phones, factory controllers, set-top boxes, etc. The .NET Compact Framework uses some of the same class libraries

as the full .NET Framework and also a few libraries designed specifically for mobile devices such as .NET Compact Framework controls" and Windows Mobile Device Center 6.1 "only compatible with Windows Vista or Windows 7 on PC if want to sync content between mobile phone and the computer." [3]

A. Mobile Phone user Interfaces

This interface contain main page of Telemedicine _ Mobile Phone in Figure 5.a contains two textbox for data store of the message requirements: data and phone number in addition to tow submenus: the first sub menu is sensor which leads to sensor simulation form in Figure 5.b, which has a random function to generate random numbers used for system test. It submits the random data in the menu page If OK pressed and the second sub menu is setting that lead to settings form in Figure 5.c which consist of patient information such as patient phone, doctor phone, center phone, sensor type, a notepad file used.

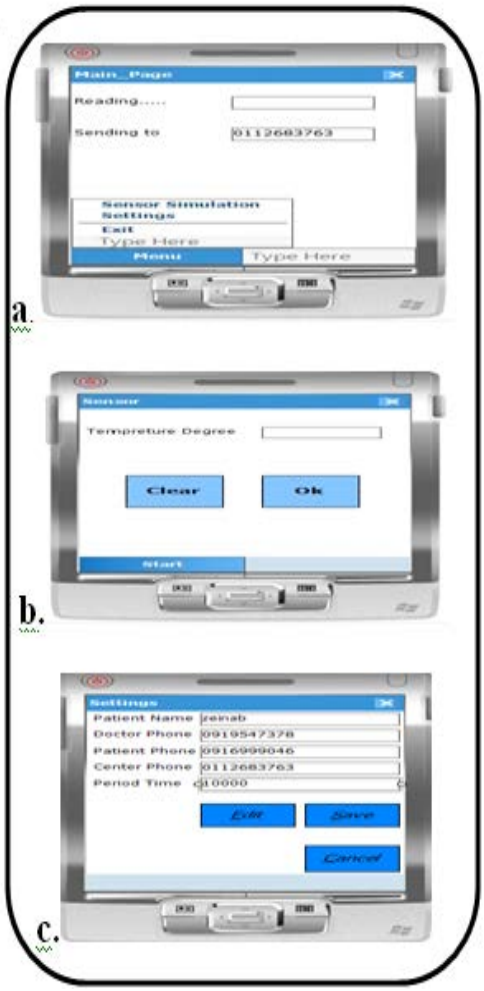

Figure5. a. Mobile Phone main page . b. sensor simulation form c. settings form

B. Sending information to the center point

Microsoft.WindowsMobile .PocketOutlook is used ti Sending information from HTC Outlook. The send( ) function "defined in this library" is used to send data from HTC to center point , this function requires tow parameters: phone number "the center point phone" and the message " contain information time and date after compose it from of RTP command of the Special purpose Communication Protocol".

The Special purpose Communication Protocol has additional special SMS based Special purpose commands such as: RTP, PNP,UCD and UPD.

The RTP Command Used to send temperature, date and time to the center when required through SMS composed in the format : RTP+<DATA>+<date and time>. Then, the center receives this message and parses it using the same command. The PNP Command is used if the patient changes her/his phone number it must send a message contains the Old phone and new phone to the center in the format: PNP+<OldPhone>+<NewPhone>. Update Center Data **(**UCD**)** command used in parsing where the center change the phone number, it must send message to HTC contains the new phone in the format: UCD+<new center phone>. The update Patient Data **(**UPD**)** command used to pars the patient change the phone PNP message. In this case the center must send the center phone and the periodic date time in the format: UPD+<Center Phone>+<Period>. The Sensor Type Query (SRP) command used in parsing in case of use multi sensor, if the Doctor need to request particular data for example blood pressure the mobile receive this command and send it , the format is :SRP+<type>.

C. The monitoring Center software Design

The Center PC with user interface in figure 6 contains a patient data sub menu though which the doctor can add new patient, delete, and edit patient's information. This information concatenated with its related medical information will be available on the patient information's table as name, phone number, medical information, date/time of message which continuously updated when SMS received and parsed. Notepad flat file is used to save patients information such as patient name(s), patient phone(s), data "temperature degree", and date/time.

Query button is used to search and report patient(s) information using phone number.

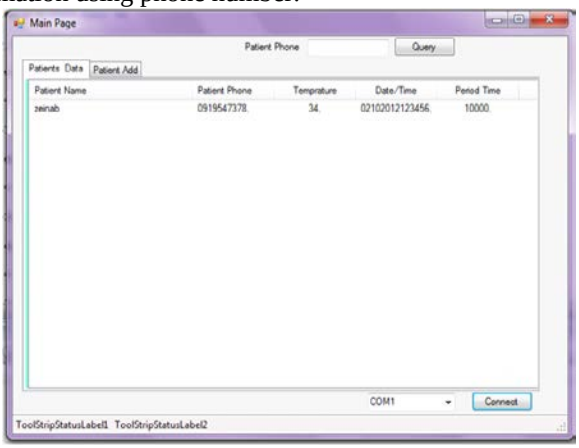

Fig. 6 Center unit user interface

To run this system on the real world, the doctor has to install the center unit software on his PC supported with GSM modem , run the software and press connect bottom for GSM connection.

When periodic medical status such as blood pressure, cardiac etc is required for a patient, chose the suitable sensor, install and run the patient unit software, press add patient on center unit software and enter the patient phone number, medical information type and the period required for check. Then, the system will periodical send the requests at patient unit, compos and send required information at patient unit then receive back the information at the patient unit.

Therefore, the doctor can check information report for every of his patient by entering part of his phone number to the query with special attention of emergence information if occurred. This system is designed and ruined successfully using random numbers generating functions instead of the medical sensor.

V. Conclusion

Using available communication equipment (mobiles) and PC (laptop) without extra payment can increase the health care system performance, reduce time and cost for patient's travelling, helps doctors, and government.

Designing this design system by prophetical phone companies and required accessories (sensors and wires) provided in the same manor of the 2USB head set or wireless standers such as IR or Bluetooth, makes easy to apply.

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