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The Importance of E-Learning and GSM Alarm System in the Medical Engineering

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Abstract
The present social context is disturbed by questions, diversity, complexity, and the time and space parameters. Thus it is justifying the change of institution activity at news requirements which oblige and which sometimes are contradictory. That is why a special importance presents the adaptation capacity of entities to continuum improvement of their offers. Thus, the aim of this paper is to present new aspects which can increase the medical services quality. Much more, the paper represents an interdisciplinary approach because it presents the importance of integration of technical aspects with the learning system founded by technology, Internet and electronic materials, all integrated of medical engineering.

Keywords: Alarm system; E-learning system; Patient; Health area.

Introduction

Taking into consideration the health problems nowadays, the medicine and engineering have to collaborate in order to solve the medical issues in a better and faster way.

It is almost impossible to have a correct diagnostic about a disease, no matter in what area of medicine, without the support of a medical device. Even if, we refer to a simple blood analysis or to a sophisticated nuclear magnetic resonance spectroscopy the engineering factor has to co-exist.

Medical engineering is trying to offer a real support for medicine and for the problems that it encounters, providing the technical requirements in order to have the best answer to the issues. The technology is developing faster and it is important for the medical engineering filed to keep up with this in order to implement the latest technologies in medicine devices. Therefore, an essential point in this engineering medical field is occupied by communication. Almost that is not any day in which not to hear that communication is vital. We can not live without it. Starting from here it is very important to have a fast and stable communication channel between the medical devices on one side and also between the patient and the doctor on the other side. Since, the GSM (Global System for Mobile telecommunications) technology appeared, it was quickly adopted and used in medical engineering.

This paper represents a comprehensive study about a GSM alarm system used in medical area. The application is designed primarily for persons with cardiac problems. It offers the possibility of monitoring the blood pressure and also the possibility to communicate the results through SMS

messages to a medical clinic. This is very important because it allows monitoring of blood pressure at set time intervals. Based on these set time intervals, a chart of blood pressure can be designed to show how the patient is responding to medical treatment. Worldwide, these types of alarm systems are expanding, to due to the fact they permit the communication through the SMS technology between the user and the medical institutions that provide the service [1]. In the same time, the paper offers a new perspective in the medical engineering through the e-learning system integration in this domain. This paper shows the benefits for patients that use the e-learning system. The aim of this paper was to show these benefits in the view of learn of use the GSM alarm system for cooperate with the medical personal.

Material and Method

The advances informational technologies contributed to the motivational increase towards the study of some disciplines, which have nothing in common with informatics. All because they facilitate learning, due to the fact that the individual particularities of the student are taken into account, also his/ her capacities and preferences. This aspect assures the existence of feedback between the student and program, increasing the efficiency of the learning process. Thus, the informational technologies are used more frequently in a diversity of the human activities' spheres: medicine, finances, mass-media, in education and science.

The development of Romanian medicine and its alignment to modern techniques required the design of new study programs in Romania. At the national level, the specialists involved in the "education" phenomenon claim that the system needs to be reformed and modernized, not only in general, but also the relationships, including the feed-back among its various elements: teachers, students (which in certain cases can be even the patient), basic qualifications, integration of the communication and information technologies, investment efficiency, learning foreign languages, lifelong professional orientation/counselling, system flexibility, so that to be accessible for everyone, mobility, education in the spirit of active European citizenship [2].

E-Learning is a type of Technology supported education/learning where the medium of instruction is computer technology, particularly involving digital technologies. E-learning has been defined as "pedagogy empowered by digital technology" [3]. In some instances, no in-person interaction takes place. *E-learning* is used interchangeably in a wide variety of contexts. In companies, it refers to the strategies that use the company network to deliver training courses to employees. In medical domain it refers to deliver training courses, especially, to the patient.

Also, more than a new type of distance education and training, e-learning represents a business solution, a successful option for the institutions which offer training courses. The need of e-learning and its benefits are clear, but the main problem is how this kind of education can be integrated in the existing structures of the institution. E-learning is more than a technical system, it is a socio-technological system, which functions best when the innovating capacities of the technology collaborate harmoniously with the talent and creative energies of the members of the educational and training institutions and trainers. It is shown that the e-learning is efficient in socio-economical and medical fields because the Internet has led to an exponential increase in information [4].

The convergence, by the background of major changes in social, of few factors as: the technological development, the new pedagogic theories and the responsibilities division for education with divers others institutions – lead at the characteristics which give the measure of this paradigm:

- the roles fluidity through the continuous rock of role educated-educator in the learning group;
- curriculum oriented to the particular necessities of student (patient);
- distributed resources through the utilization/the integration/the access of electronics libraries and multimedia materials;
- virtual facilities;
- asynchronous lessons.

No matter the background or where e-learning takes place it is an education focused by the

person who learn.

E-Learning system represents a planed experience by teaching-learning, organized by an institution which provides materials assisted in a sequential and logic order for students for they assimilate these in their personal manner. In this kind of activity the agents of activity are not constraint at co presence and synchronism. The mediation is realised through different modalities as CD material, technologies which transmit the contents through Internet [5].

The aim is to provide knowledge and/or abilities, the means are by using an attractive environment. In e-learning systems, the top research at international level is focused especially by psycho-pedagogic factors and not only by simple representation of knowledge. In this context we propose take into account the following individual particularities: previous knowledge, learning style, needs and motivation. On the basis of those attributes can develop an adaptive educational content, which starting from users' traits, builds a particular learning model, which is efficient and it based on the users' motivation. All these aspects are the important elements in the medical domain especially that the degree of customization of the medical services is high and the relation between doctor and patient is powerful. In the same time, the possibility of medical services standardization is low. In this paper which is focused in the medical field the students which participate in the e-learning system are the patients.

The e-learning system in medical engineering has some particularities as:

- both the patient and the doctor can be fellows which use this system;
- the patient plays the student role;
- the doctor can take the role of a student or of a teacher;
- this system of learning can increase the confidence of patient in the medical domain;
- the evaluation component isn't absolutely necessary as then when e-learning is used in education domain.

Thus, the digital environment extents obviously the sphere, being used to provide information and to express ideas in different manners: verbal, visual, auditory or a mix by all these. Internet becomes, in every day, the referee of education and culture access. E-learning is the most adequate form from to come in the meet of knowledge needs and continuous formation [6].

The *e-learning benefits in medical engineering* are:

- permits the quick integration for new patients/doctors;
- the patient/doctor chooses the moment for training and has any-time access to information;
- the knowledge offered is divided and easy of access;
- assures training for a great number of patients/doctors and diminishes transport costs for training;
- the costs of delivery are low;
- the questions post-training can be elucidated any-time;
- reports about the learning process are offered;
- the training effect regarding organization's performance is estimated.

The bigger and bigger competition of the present times stressed the strategic importance of satisfaction and of quality in the competition for to gain consumers and for to maintain certain substantially competitive advantages [7]. Thus, the satisfaction is focused on consumers expectations and on theirs perception over services quality [8-11]. Therefore, the entities must try understand theirs target markets (students or externals partners by different types), value the needs of these markets and modify the offers to meet these needs, contributing thus to one development of consumers satisfaction through services with higher quality [12].

Thus, today, to survive organizations must know their customers very, very well [13]. Only in this manner the organization can obtain the competitive advantage.

E-learning offers to medical institution substantial advantages and it is perfect adapted to specific and exacting training in business. The stages in development e-learning system are:

1. *Analysis of needs*: The identification of the target group (patient/doctor), needs analysis of training, solutions for online education, comparative analyses.
2. *Design and projection instruction*: specific training models, type of contents, learning styles, settings the objectives, standards of quality.

3. *Development* of the e-learning system: the settings of content and its structure, visual design, demonstrations, simulations, laboratories, tests, support materials, specific methods of training, interaction methods (synchronous: chat, asynchronous conferences: discussions forum, e-mail).
4. *Implementation* of system requirements: Analysis of context, the settings responsibilities, the assessment of the content, the list of activities, the evaluation of performances, barriers in implementation.
5. *Management* of e-learning systems: necessity, education distance programs marks management.
6. *Evaluation* of e-learning programs which will contains: comparisons between the evaluation of e-learning programs and the classic evaluation, strategies of evaluation, the evaluation of courses materials, self evaluation. In the medical engineering this aspect can be applied especially to doctors.

A good deal of the literature also suggests that e-learning can transform learning experiences in positive ways, resulting in an increase in the quality of learning experiences [14-16]. In particular, it has been argued that e-learning technologies facilitate the development of argument formation capabilities, improve written communication skills, require greater complex problem solving abilities, and increase opportunities for critical and reflective thinking [17-21]. An important part of these capabilities can be met in the medical field then the patients use the e-learning system.

In essence, e-learning offers an efficient access to information and most of the new knowledge, for the new and efficient teaching, learning and evaluation methods of knowledge, instruction and continuous formation. E-learning is an alternative to the classical education in the today or tomorrow *computers society* too. Thus, the patients can learn how they can the GSM alarm system to monitor their blood pressure and they have the possibility to communicate the results through SMS messages to a medical clinic.

Based on SMS technology, the GSM alarm system was specially designed to meet all the technical requirements that are needed for a device to work properly in GSM network.

SMS stands for Short Message Service. It is a technology that enables the sending and receiving of messages between mobile phones and first appeared in Europe in 1992. It was included in the GSM (Global System for Mobile Communications) standards right at the very beginnings [22].

As suggested by the name "Short Message Service", the data that can be held by an SMS message is very limited. One SMS message can contain at most 140 bytes (1120 bits) of data, so one SMS message can contain up to:

- 160 characters if 7-bit character encoding is used. (7-bit character encoding is suitable for encoding Latin characters like English alphabets)
- 70 characters if 16-bit Unicode UCS2 character encoding is used. (SMS text messages containing non-Latin characters like Chinese characters should use 16-bit character encoding) [22-24]

The GSM alarm system consists of four main electronics blocks:

- CPU module (ATmega64 Microcontroller);
- GSM modem module (MC39i GSM modem);
- Switch mode power supply module;
- Inputs module;

ATmega64 microcontroller

The ATmega64 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega64 achieves through puts approaching 1 MIPS per MHz, allowing the system designer to optimize power consumption versus processing speed [25].

The ATmega64 provides the following features: 64K bytes of In-System Programmable Flash with Read-While-Write capabilities, 2K bytes EEPROM, 4K bytes SRAM, 53 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), four flexible Timer/Counters with compare modes and PWM, two USARTs, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain programmable Watchdog Timer with internal Oscillator, an SPI serial port, IEEE std. 1149.1 compliant JTAG test interface, also used for accessing the On-chip Debug system and programming, and six software selectable power saving modes. The ATmega64 AVR is supported

with a full suite of program and system development tools including: C compilers, macro assemblers, program debugger/simulators, In-Circuit Emulators, and evaluation kits [25].

GSM module (MC39i)

Designed for operation on GSM 900 MHz and GSM 1800 MHz networks, MC39i support GPRS multi-slot class 10 and the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. To save space on the application platform, MC39i comes as an extremely slim and compact module. This makes it ideally suited for a broad range of mobile computing devices, such as laptops, notebooks, multimedia appliances, and particularly offers easy integration with PDAs, pocket organizers or miniature mobile phones [26-27].

The tiny MC39i module incorporates all you need to create high-performance GSM/GPRS solutions: base band processor, power supply ASIC, complete radio frequency circuit including a power amplifier and antenna interface. The power amplifier is directly fed from the supply voltage BATT+. The MC39i software is residing in a flash memory device. An additional SRAM enables MC39i to meet the demanding requirements of GPRS connectivity. The physical interface to the cellular application is made through a ZIF connector. It consists of 40 pins, required for controlling the unit, transferring data and audio signals and providing power supply lines. The serial interface offers easy integration with the Man-Machine Interface (MMI), remote control by AT commands and supports baud rates up to 230 kbps [26-27].

Switch mode power supply module

To power up the system, it is used a 10-15 DC voltage source and the LM2576 integrated circuit (switching voltage regulator). The voltage is filtered and stabilized resulting in a continuous 4.5 Volts. This voltage is used to supply all the others electronics blocks including the microcontroller and the GSM modem. The power supply also provides short circuit protection by limiting the output current.

Inputs module

The GSM alarm system, can be connected with any type of sensor that has a digital contact (biomedical sensor, motion sensors, temperature sensor).The inputs are galvanically isolated from microcontroller with four optocouplers, for any situation where the input signal source is different from the power supply of the GSM alarm system.

Results

Once powered, the Pulse Generator Module (PGM) produces a specific impulse for starting the GSM modem. The GSM modem, MC39i, will try to reach the GSM network. This is indicated by a LED that flashes when accessing the GSM network every three seconds. If the LED pulses every second, it means that the modem is still trying to connect the GSM network. Once connected (the LED flashes every three seconds) the microcontroller periodically reads the SMS reception. The short period of reception of message represents an advantage in the medical area because the life of patient can be saved.

There are two ways in which this alarm system works. The first one is that the user can interrogate the system with a short SMS message. This message has to respect some standards which are configured in microcontroller. This “Status Message” has to be “Alarm Status” and very important to be send from a specific SIM (Subscriber Identity Module) card which specifications are also saved in the microcontroller memory. If all these things are checked regarding the message context and phone number, the alarm system responds with one of the following messages: “Blood pressure ok” / “Blood pressure not ok” or “System fault”. If the device receives a SMS with the text "Reset" the alarm system resets, turns off and restarts, after a programmed time, named "Reset Time", which is saved also in microcontroller. These messages may be modified as desired to meet different application requirements. Also, the values of inputs (blood pressure values) can be modified as to adjust to each user particularly. This operation is done using special software

through the serial configuration interface that enables all these operations.

On the other hand, the inputs are checked periodically and if one or more are active a SMS message is sent to the user telephone number or to the doctor in charge of the patient, or both cases. For instance, if the blood pressure is under / upper a specific value recorded in the microcontroller, a SMS message is send to the user and/or to the doctor, notifying about the blood pressure status.

Discussion

The main advantage of this system is not the possibility to create a database, but to help in the monitoring of the patients parameters. Other advantage of this system is that not only blood pressure can be monitored but also other parameters.

So, being able to remotely communicate the blood pressure status is a very important fact for the user of this technology and also for the medical clinic in charge with patient monitoring, because there can be implemented a database with the blood pressure results. From this database inputs the doctor and the patient can learn and observe how the medical treatment has gone and in what period of time the blood pressure was within the normal values.

All these aspects show that the use of the e-learning and the GSM alarm systems in the medical engineering are very important. This importance is given by the benefits which carry into effect the use of e-learning system for the patients who learn in this sense how to use the GSM alarm system in medical domain. Thus, it is very simple way for the patients to understand the benefits of this system through e-learning. In the same time, the use of e-learning system for this technology offers a big advantage, that the patients can obtain a quick feed-back. Much more, the entities which result from these new technologies gain the competitive advantage and they will be more and more attractive and efficient.

The specifics attributes of e-learning technologies offer new opportunities in medical domain.

The GSM network is now available in many countries and it is stable. SMS communication within the GSM network is one of the features of mobile communication which is used millions of times every hour. Usually a "short message" is typed character by character from the keypad. What is transported is simple text which can be generated and interpreted by many modern control systems. Therefore a control system could be a sender as well as an address. Following this idea it is easy to think of an alarm system sending an SMS as soon as an error is found. Such a solution would enable systems that are not permanently supervised to send an SMS message as soon as a specified condition is identified.

As soon as we have started using SMS for alarm messages it is clear that SMS messages could be used in some other ways as well. For example, one possibility is to ask the controller for data via SMS. Based upon a predefined syntax it is possible to send an SMS requesting specified data and the system to answer using a SMS message as well. This allows getting information out of the process, as long as the GSM network is available. Another possibility is to directly modify data within the controller. Again we need to follow a predefined syntax which allows setting a variable to the value we need. Both ways, request and send data of process variables have to be secured against unauthorized use. As an SMS message contains the phone number of the sender we can configure which phone numbers are allowed to use this service.

Understanding the GSM network may not revolutionize the medicine but it might help us make medicine more efficient.

Conflict of Interest

The authors declare that they have no conflict of interest.

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