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A well-designed Health Information System Solution for Effective Communication

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ABSTRACT

For the provision of exceptional healthcare services, effective communication between medical staff and patients is paramount. Our proposed solution, which allows patients to send text messages through a healthcare facility, is convenient and widely accepted, providing reassurance about its practicality. From the healthcare facility's perspective, automating this form of communication can significantly reduce staff workload, enhancing operational efficiency. Therefore, this well-designed information technology solution has the potential to revolutionize various operations within a healthcare facility, instilling confidence in its practical benefits.

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1. Introduction

SMS (abbreviated from Short Message Service) stands for a communication protocol which enables mobile phones users to send and receive short textual messages [1]. There are many different standards for exchange of textual messages and they are continuously being developed and improved by adding new features (e.g. sending and receiving formatted text, images, audio and video). Nevertheless, in the context of this paper, text messaging typically refers to SMS, with its 160 ASCII characters limitation.

In this paper we firstly discuss the advantages of using SMS in communication between a healthcare institution and the patients by using SMS protocol. Then we analyze architecture and implementation of our system for automated sending and receiving of textual messages. Finally we describe one typical use case of our system.

It is important to notice that our system for automated sending and receiving of textual messages is implemented as a part of medical information system Medis.NET. Medis.NET is being developed at Faculty of Electronic Engineering in Niš and more details about the system can be found in [2]. Anyway, system for automated sending and receiving of textual messages is a complete system itself

and can be simply used in conjunction with other medical information systems as well as with other information systems which can be improved by adding SMS communication with their users.

2. SMS Communication – Cons and Pros

We must agree that SMS is, in terms of information technology, relatively old standard (with the first officially transferred message in 1992.) [1]. It is also a fairly limited technology allowing users to transfer only 160 ASCII characters. Actually most of modern mobile devices do allow their users to use different character sets and multi-part messages, but it is a good practice when designing a system to keep in mind the worst case scenario. And there are many more characteristics of SMS which encourage us to use this kind of communication integrated with a healthcare information system. Here are listed some of them.

2.1. Number of Devices which Support SMS

According to data from [3], there are less than 2 bilions of Internet users and more than 5 bilions of mobile phone users in the world registered in 2010. It is further estimated that 98% of those phones have text messaging capabilities.

2.2. Geographic availability of Mobile Networks

The fact is that mobile phone networks cover significantly larger areas comparing to fixed phone networks and cable or wireless Internet. Although Internet coverage is constantly growing, the advantage on the SMS side comes from its minimal demands regarding the quality of the network. This is especially important in areas with low population density where Internet service providers do not have economic interests to build their networks. In such areas quality of mobile phone network is often below the level required for mobile phone conversation and SMS remains as the only one way of communication.

2.3. Simplicity of Usage

The most of mobile phone users agree that it is very simple to type and send/receive a short textual message. Also, for a number of these users it is too complicated to use Internet or send/receive an e-mail.

2.4. Immediacy of Action and Response

Most of the mobile users keep their mobile devices always by themselves and turned on so the users can receive important information with the least possible delay and act accordingly. This is an advantage of SMS communication over e-mail and web where most of the users are not always online and healthcare institutions lack a possibility to quickly notify such users of some important information if needed.

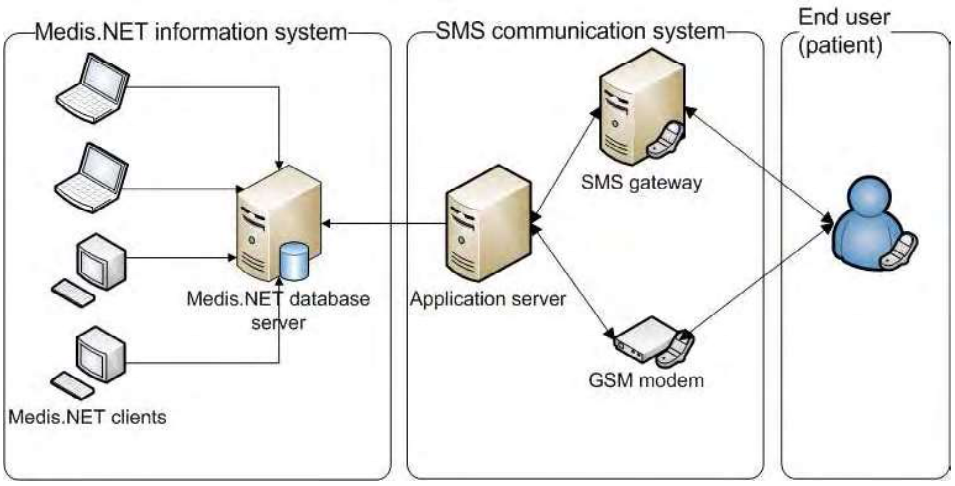

Figure 1. System for automated sending and receiving of textual messages

2.5. Broadcast Possibilities

It is possible to quickly and easily transfer information to a large number of users through SMS (for example to all patients registered in a healthcare institution database). In this case SMS outperforms traditional phone calls.

3. Implementation

Our system for automated sending and receiving of textual messages operates as a "middle layer" between existing Medis.NET information system and patients (Figure 1.).

Left part of the diagram shows existing Medis.NET information system. Medis.NET manages patient's Electronic Health Records (EHR), patient's visits scheduling, work scheduling for employees, maintains financial data regarding provided services etc. All the data is kept in a central database and can be accessed by the employees of healthcare institution through Medis.NET client application.

Central part of the diagram shows our system for automated sending and receiving of textual messages. Core logic of our system is running as a service on application server node. This service listens to existing Medis.NET database for data modifications. If an important data for a patient who is subscribed to this service is modified then the service sends appropriate text message to the patient (e.g. some biochemical laboratory analysis for the patient are finished and service sends some most important results in the message also reminding him/her to collect full list of results at the healthcare institution).

Core messaging service also maintains the data about patients' subscriptions to our system and stores them in a small database on the same server.

Third role of core messaging service is to choose appropriate interface for sending messages. As shown in Fig.1. there are two possible interfaces – SMS gateway and GSM modem.

SMS gateway is a service provided by a GSM service provider company. SMS gateway can be exposed as a web application or a web service and depending on that our core messaging service accesses it by using HTTP for web application or SOAP for web service.

GSM modem is a specialized type of modem which accepts a Subscriber Identity Module (SIM card), and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem behaves just like a mobile phone. From our perspective GSM modem compared to standard mobile phone has some advantages (can be connected at the same time both to external power supply and to our server by a cable connection).

Provided with these two interfaces, our core messaging service can make a choice which one to use based on configuration parameters. Usual configuration settings are such that SMS gateway is used with a higher priority because of its lower price per message and higher throughput. GSM modem is used only as a back-up interface in case of failure of the SMS gateway.

4. A Typical Use Case Scenario

In this chapter one interesting usage of our system for automated sending and receiving of textual messages will be described. We use it here to improve an existing system for patients' visits appointments.

Medis.NET information system already has a sophisticated module for scheduling employees work time and appointing patient's visits [4]. This system supports automatic generating of work time schedule for employees and splits generated work time into time slots for patients. Duration of time slot is configurable, based on employee's specialization and work area (e.g. 15 minutes for general practice medicine, 20 minutes for dentistry etc.). For most specializations and work areas this approach works fine but there still some departments which make appointments for their patients on daily bases and not for precise hour and minute. Also for some work areas time needed per patient can significantly vary, for example from 15 to 30 minutes.

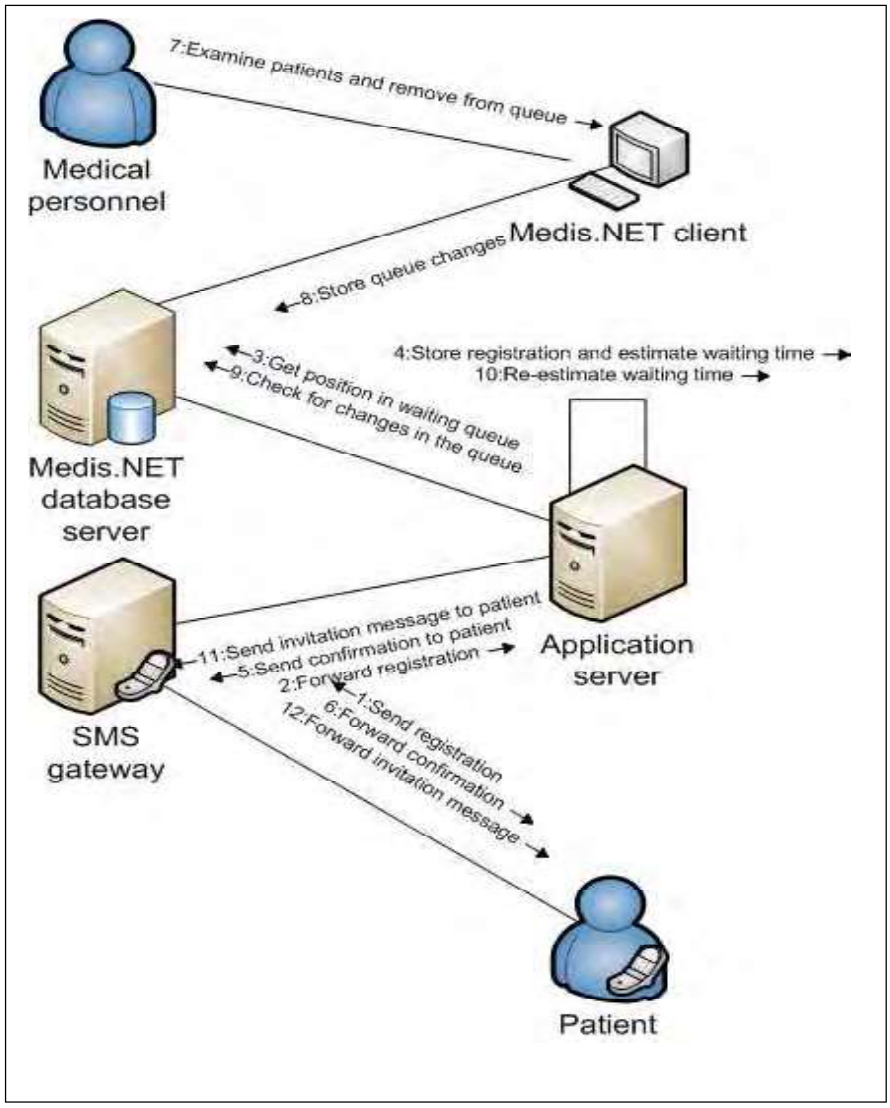

Figure 2. Using system for patient notification

In such cases our system for automated sending and receiving of textual messages can enable patients to quickly check their appointment status, get estimation when they will be examined and/or get an invitation message 30 minutes before they should come to doctor's office.

Take for example a patient who already knows that he has an appointment today, but healthcare institution can't provide him exact time of his visit. Instead of waiting several hours at the institution the patient can use our SMS service as shown on Figure 2.

1. Patient registers for our service by sending an SMS containing service keyword and his Social Security Number.

2. SMS gateway forwards the message to core messaging service.

3. Core messaging service checks appointments and position in waiting queue for this patient.

4. Core messaging service estimates time when the patient will be examined and stores his registration in messaging database.

5. Core messaging service creates a confirmation message containing estimated time when patient's visit should start and information that he will receive one more message 30 minutes before that.

6. SMS gateway forwards confirmation message to the patient.

7. Doctor at healthcare institution examines patients and removes examined patients from the waiting queue using Medis.NET information system (Figure 3.).

8. Modifications from Medis.NET client are transferred to Medis.NET database.

9. Core messaging service detects modifications in Medis.NET database.

10. Based on new data in the waiting queue, core messaging service makes new estimation of the waiting time.

11. If new estimation of the waiting time is about 30 minutes core messaging service sends invitation message which contains new estimation for examination start time.

12. SMS gateway forwards invitation message to the patient (Figure 4.).

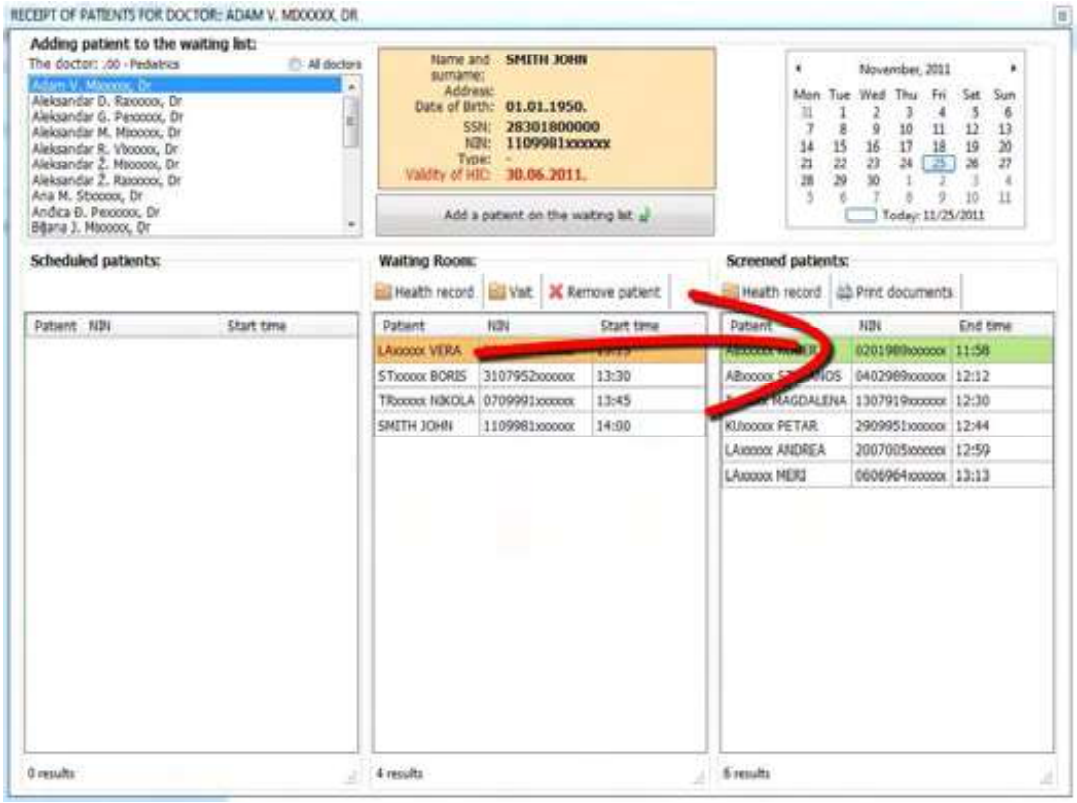

Figure 3. Medis.NET application used by medical personnel shows lists of scheduled patients, patients in the waiting room and examined patients

7. Conclusion

In this paper we presented our implementation of a system for automated sending and receiving of textual messages. Motivated by existing systems in different areas such as e?learning, e-banking, marketing etc. ([5], [6], [7]) we designed our system as an improvement of a medical information system.

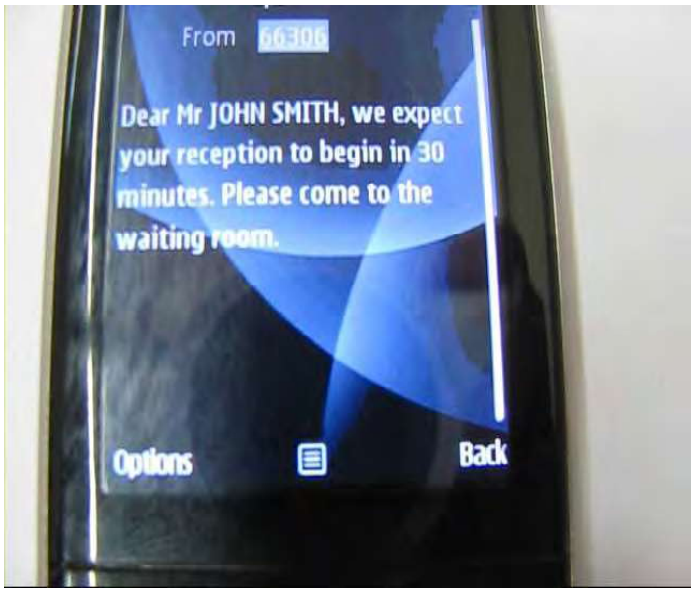

Figure 4. Invitation message received on patient's phone

Use case presented here is planned to assist medical personnel in scheduling patients' visits and to reduce waiting time for the patients. Our plans for future work include some more services for patients based on the system for automated sending and receiving of textual messages. One possible extension is related to biochemical laboratory. When some analyses for the patient are finished the service would send most important results in the short message also reminding patient to collect full list of results at the healthcare institution. It is also possible to create a notification service which would warn a patient that a period of time has expired since his/her last visit to a doctor (for example 6 months after visiting dentist) and remind patient to consider scheduling a new visit. Another possibility is to create a service which would broadcast warning messages about changes in weather conditions to all registered patients with chronicle diseases which could be affected.

Although we listed plans for extending our messaging service in healthcare area, it is important to notice that the service is not limited to this area and that it could easily be coupled with other kinds of information systems.

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