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MEDICAL ADHERENCE SYSTEM USING IVRS

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Abstract— Adherence is the degree to which patients conform to a given treatment plan. Despite the potential for serious psychiatric or medical consequences, patients do not always adhere to their prescribed medication regimen. In this paper, we will introduce a GSM based system and interactive voice response system for improving the medication adherence of the patients.

Keywords—GSM modem, Voice response system.

I. INTRODUCTION

Medication adherence is the degree to which patients conform to a given medication regimen. On average adherence is less than 50% regardless of the illness under treatment [1]

The most common ways of assessing adherence are based on patients' self-reports, care takers' reports, pill counting or measuring drug levels in patients' blood and/or urine specimens. The common criticism of all such approaches are that they unreliable and impractical [2]

During last decade, devices have been developed [3,14] for increasing the patients' adherence. These devices, in general, are able to alert the patient at the time for taking the prescribed medication. Additionally, most of them provide monitoring features and inform the physicians in case of missed doses. [9]

II. RELATED WORKS

Furthermore, there are platforms [3-10,12] such as C-Monitor [10,11] and @HOME [12,13], which are web-based applications for monitoring medication adherence. The C-Monitor platform is a flexible platform, where physicians can create scenarios and personalize the therapeutic regimen of each patient. Additionally, patients are able to provide relevant information and communicate with their physicians by e-mail service.

The @HOME platform is a home care platform, which enables physicians to monitor medication adherence of patients suffering from chronic illnesses such as schizophrenia, utilizing the Smart Cup [14] by AARDEX.

The system which is based on SMS is also a constraint because everybody in the world cannot read andour aim is to provide a better adherence for old aged people

Although these dispensers are available in the market and have been used in many trials they have two main drawbacks: limited portability, since they are often the size of a coffee machine and the need to be connected to POTs in order to convey the recorded data.

In this paper we will describe a medication adherence system, which is fully ambulatory and does not depend on POTs or other non-mobile technology

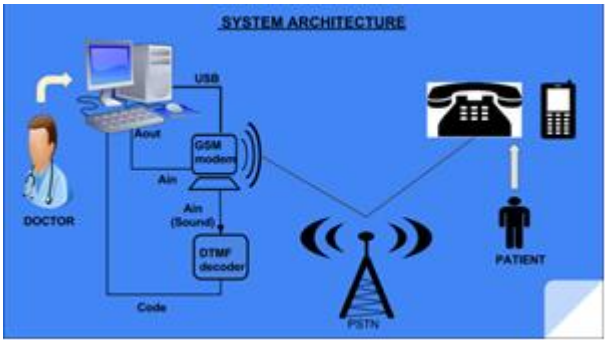


Fig. 1: Overall system architecture of the medication adherence system.

III. PROPOSED METHOD

Our proposal was to develop an interactive system, which reminds the patient to take his tablets with the help of the GSM network. The system makes a call to the patient on a specific time according to the medication timetable defined by their physician. The default content of the call, which can be modified by the monitoring physician, is the following:

"Medication Reminder: Your next dose is now due. Please confirm you have taken it by replying by pressing on DTMF pad"

The adherence system (which is our doctor PC) is waiting to receive the patient's reply. If no reply has been received after 3 calls also, the PC (see Fig. 1) resends the reminding call me to the patient. That happens thrice in case of the patient has not replied. Finally, the PC treats the event as "missed dose event"

IV. SYSTEM DESCRIPTION

A. Overall Architecture

The system configuration is composed of two groups of interlinked components, the clinic subsystem and the home subsystem. The first group is located at a clinic (Adherence

PC, Database, PSTN Gateway, Clinician's Terminal) and the other group is at the patient's home (Patients cellular phone,). A GSM communication link is established between these two physically separated parts for inforation exchange (see Figure 1)

B. Adherence PC

The adherence PC runs appropriate software that sends andreceives calls to/from the patients cellular phone.

In addition it analyses incoming data.

This component runs as a standalone application or Windows

Service. This application has been developed with C# and Visual Studio .NET 2004

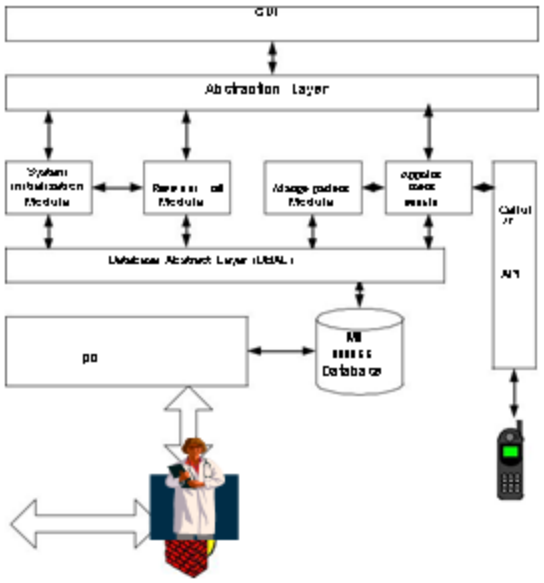


Fig 2: Module diagram

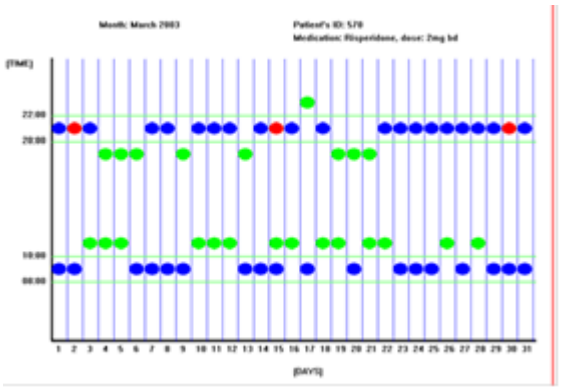
V. SYSTEM REQUIREMENTS

A. Software requirements

.Net Framework: 4.0 and above
Language: C# Programming language
API: Microsoft Text to speech API
OS: Windows 7 and above
IDE: Visual Studio 2010 and above
Database: MS Office Access

B. Hardware Requirements

GSM Modem: 2G
DTMF Decoder
Desktop/Laptop
Telephone/Mobile
Processor:Intel ® CoreTM i5-4210U CPU @1.70GHZ
RAM: 4.00 GB
Hard Disk: 500GB



1) Graphical User Interface (GUI)

The GUI visualizes patients' data and medical reports. It offers a way to control the administration for the doctor

Abstraction Layer

The abstraction layer hides complex functionality of the underlying internal component layer from the GUI. It offers much more high-level functions to access other components.

2) System initialization Module

This module analyses the stored data and produces the appropriate alerts for notifying clinicians regarding patients'
non-adherence.

Reminder Module

This module is responsible for producing medical reminders
Using appropriate AT commands using GSM module

Mange patient Feedback Module

Makes call to concern patient for feedback using AT commands
And by generating dynamic voice using Microsoft Text to Speech API and DTMF tone as input from patient

Appointment Module

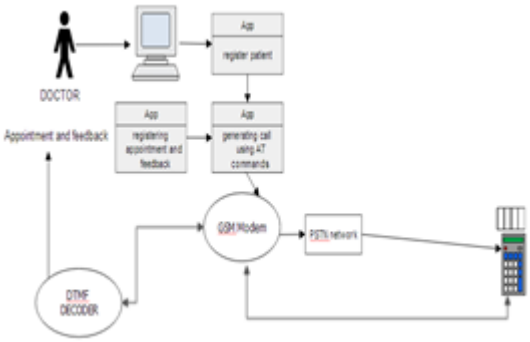
This module gives the application the capabilities of making
An appointment with doctor
Database Abstraction Layer (DBAL)
The database abstraction layer hides the complex functionality of the SQL database. It provides high-level

function for storing and receiving data from the SQL

database. The DBAL has been developed as a COM object.[15]

Cellular Phone API

The cellular phone API provides the necessary commands for receiving and sending SMS messages via the GSM network. [15]



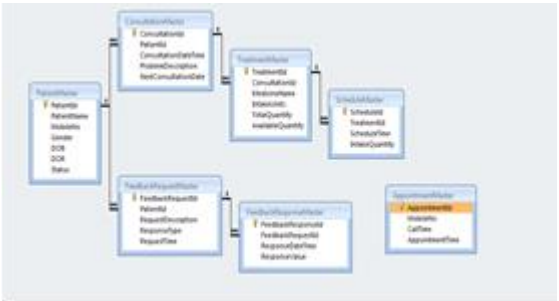
Data flow diagram

The patient's details are maintained at the server application in the doctor's PC. Once the application is started, it communicates with the GSM modem to initiate a call to the patient's remote mobile/telephone through PSTN network. When the call is connected, medical reminder will be sent to the patient.

At the end of the call, feedback is recorded from the patient about the ongoing treatment and the same is sent back to the doctor's PC via GSM modem and DTMF decoder.

The database is the central point of storage for all the system's data. A relational databaseserver is used for the database implementation. For that purpose, we use a Microsoft Excel. The database provides information about patients data, medication list, health care provider, patient medication timetable, feedback and full history of the system activity for security reasons. The schema of the database is shown in Fig. , below.

Database schema



VI. DISCUSSION AND CONCLUSION

Low rates of adherence with prescribed medication regimens pose a major challenge to the effective management of most chronic disorders. As previously discusses less than 50% of patients manage to adhere to their treatment. The implications of poor adherence are inadequate treatment outcome leading to increased medical costs and poor quality of life. For this reason, the need to develop effective interventions is more important than ever before as social and medical costs of non- adherence are high – and hospital fiscal pressures to reduce in-house treatment costs are growing.

The proposed system provides clinicians with the ability to identify non-adherence in a reliable way with the least possible inconvenience for the patient. This will improve clinician-patient relationship in terms of promoting discussion regarding medication and therefore identifying and reducing barriers to adherence. It also offers the opportunity for early intervention and therefore has the potential to prevent relapse or symptom deterioration.. The proposed system can be applied to any patient group but it is particularly relevant for those conditions where there is a need for long-term treatment and where non-adherence has direct negative impact on health outcomes.

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