Home Monitoring of Hypertensive Patients through Intelligent Dialog System

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1. Background and setting
The telephone has been used in medicine since its appearance [1], but only in the last years its use has been integrated with the most recent telecommunication tools. The recent mixed initiative spoken dialogue systems are a natural evolution of the technology in this domain.

In the framework of the E.U. project "Homey", we built an intelligent dialogue system to monitor patients affected by essential hypertension. The patients, in care at three institutional hospitals in Italy, would normally have to meet their physician approximately every 6 months. The goal of the periodical examination is to monitor blood pressure values, habits and other variables, and consequently estimate certain standard risk indicators; the physician takes account of these results in order to modify the pharmacological therapy. The aim of the proposed dialog system is to increase the frequency of the data acquisition, because a closer monitoring is likely to improve both the patient compliance to the therapy and the therapy planning [2].

The dialog strategy follows parts of world-widely accepted guidelines for the hypertension and dyslipidemia [3].

2. Architecture
Figure 1 shows a simplified view of the data flow inside the dialog system we propose. In the first place, the physician may use a conventional interface (graphics, keyboard and mouse) to store and update therapies and test results. On the other side, patients periodically call a dedicated telephone number and engage a dialogue with an automatic system that interacts with them to acquire clinical data, monitor their style of life and ask about the presence of drugs’ side effects. A database records both the detailed medical history collected during the encounters at the hospital and the data entered by voice.

When a patient dials the system’s number, the call is forwarded to a dialog manager, which uses the SPINET speech recognition system [4] and a commercial text-to-speech synthesizer. The dialog application follows a description developed in a proprietary high-level language. As proposed in [5] and [6], we required our system to adaptively construct dialogs. For this purpose, the dialog description contains logics to cope with exceptions and alternative dialog schemes. The dialog flow is customized in real time by two agents, whose task is to adapt the sequence of questions to the specific patient, depending on the therapy assigned by the physician, the information gathered through the previous calls (e.g. to ask “Do you still go swimming?” rather than “Which sport do you practice?”), and during the current call.

We have also planned a two-phased evaluation study to assess the system’s performances. The first evaluation stage is ongoing: 25 volunteers received an imaginary personal profile with the task to complete 10 virtual visits each. Their phone calls are currently being collected; the utterances will be checked and manually transcribed to evaluate the performance of the speech recognition system, given the language models and the dialog strategy. The second test stage will involve real patients and the physicians; its goal will be to study the clinical effectiveness of the intelligent dialog system in the disease management process.

3. Conclusions
We have designed and developed an infrastructure for monitoring hypertensive patients. Patient information is stored in a database; this allows for the adaptive construction of dialogs. Patients avoid the inconvenience of going to frequent hospital visits to monitor the clinical variables that can easily be measured at home. Thus, the physician is facilitated in acquiring and reviewing patient information, along with the derived risk indicators, to make evidence-based decisions.

4. References

Figure 1: Architecture overview