Medical Informatics Europe '97
C. Pappas et al. (Eds.)
IOS Press, 1997

IDIS-KS: an Intelligent Drug Information System as a Knowledge Server*

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Abstract

Expert System technology in combination with other technologies such as Networks and Data Base systems can prove to be a valuable tool for medical experts, providing decision support and information services, and therefore facilitating and improving their everyday tasks. IDIS-KS described in this paper, is an consultation and information system dedicated to deliver drug information and suggestions about possible treatments to medical practicioners in the National area of Greece.

1. Introduction

Physicians and pharmacists confront in their everyday practice the problem of dealing with a large amount of information concerning medical compounds used in therapy. Not only this knowledge is large but also variable; new drugs are released and new clinical results are published. It is obvious that the distribution of this knowledge by "traditional" means (reference books, seminars, etc.) is both cost and time inefficient. The software packages developed so far dealing with this problem, are mainly data banks [6], which have little relation with the "expert system" philosophy and even less relation with the integration of all the embedded information, meaning interrelations, analysis and decision making.

This paper proposes the design and development of an Intelligent Drug Information System acting as a Knowledge Server (IDIS-KS) which will provide information and decision support services concerning drugs and medicines used in therapeutics mainly in Greece. The provided services will be available over a wide area network structure, enabling easy remote access to the interested pharmacists and medical practitioners, and can be especially useful in cases where immediate access to such information is costly or even impossible by other means.

2. Relevant Work

In most cases, medical information services are offered by data bases that provide easy access to the stored information. The Martindale[5] On-line/CD-ROM for example,

* This Work is partialy sponsored by EU under the TELEMATICS 2C project "Medical Emergency Aid through Telematics" (MERMAID), ref. no. HC 1034.

marketed by the Micromedex Inc., offers an easily accessible data base. Another example is Drugline[6], a drug information database, that offers problem-oriented drug evaluation comparable to a clinical consultation.

On the other hand, medical science has been also used as an area of application for the expert system technology before. The most well known example is MYCIN, is an expert system developed at Stanford University, which diagnoses and proposes a treatment for meningitis and bacteremia (blood infections) [1,4].

3. Our approach: the IDIS-KS Expert System

This proposed work, IDIS-KS, is a complement of a previous work done in our group concerning the development of IDIS, a prototype expert system that can suggest a possible treatment not only for a specific class, but for a wide range of diagnosed diseases [3]. This prototype system is in the rule base expert system mold; it contains a set of rules that incorporate all the information about drugs (indications, contra-indications, interactions, etc.) and the expert knowledge that enables to manipulate it. Its operation is simple; the user poses a query describing a diagnosed disease, interacts with the system providing information about the patient and receives as an answer a suggested treatment, in which possible contra-indications and interactions with other drugs that are prescribed to the patient have been considered. IDIS, being a prototype, includes only a small ammount of drugs and can deal with a small number of cases.

IDIS-KS extends significanlty the previous system by offering apart from decision support, conventional data base information services, multiple ways of presentation (multimedia, hypermedia), and network facilities.

4. Operation of IDIS-KS

The operation of IDIS-KS can be divided in two levels; the *information level* and the *consultation level* (figure 1).

In the *Information level* the system operates as a normal data base supplying information on drugs (nomenclature, indications, etc.) as well as relevant published material about new and existing compounds (clinical research and testing data, scientific articles and announcements, greek and foreign bibliography etc.). Additionally the system will inform the user of any recent changes to the stored knowledge and will incorporate hypermedia, multimedia data presentation and display tools.

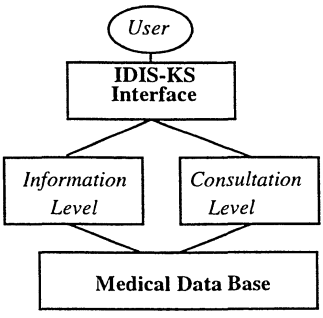

figure 1: Overview of the IDIS-KS Expert System

In the *Consultation level* the system operates as an expert system suggesting to the practicioner a proper treatment for her/his patient. The suggestecd treatment will be based on the information that is stored in the system's data base, and all possible interactions, contra-indications or other problems concerning the patient will have been dealt with and all necessary information like precautions, adverse effects, etc., will be presented in the system's output. The purpose of the second level is not, in any case, to substitute the medical expert, but to assist him in the decision making. Towards that direction the system will include explanatory facilities involving justification of the suggested treatment (*how queries)* and explanation

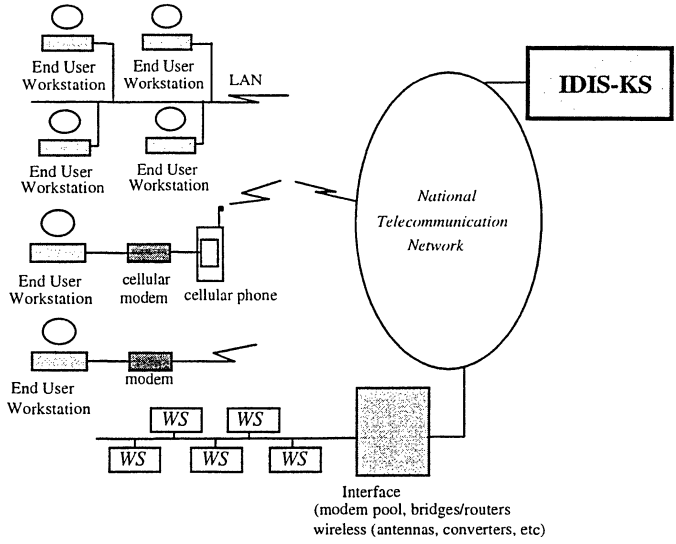

figure 2: Networking of the IDIS-KS

why a specific piece of information is requested *(why queries),* in order to provide the essential justification for the proposed treatment.

The IDIS-KS is an expert system that in its final form will provide the information and consultation services over a wide area network (using the existing telecommunications infrasrtucture), thus the expert system will act as an *intelligent knowledge server*[2]. Special consideration will be taken so that the system will be accessible through all possible offered networking protocols and services in the national area of Greece, (cellular communi-cations, IP networks, ISDN, GSM, ATM, etc.) making it available to everyone interested (figure 2).

5. Structure of IDIS-KS

IDIS-KS is comprised of three parts, the *Medical Data Base*, *Intelligent Tools* and finally the *Interface* (figure 3).

The *Medical Data Base (MDB)* is a conventional data base, dedicated to the storage of all relevant data concerning drugs and medical compounds. The knowledge contained in the data base will be created by medical experts, who will be responsible for its entry, update and verification.

The *Intelligent Tools* part consits of the information and consultation tools of the system and can be further devided in two subparts:

1. *The information management part* that provides the access facilities to all information stored in the MDB; it includes the knowledge discovery tools, data integrity and quality control, hypermedia and multimedia management tools, data presentation and display, etc.
2. The *decision support part* that implements the consultation level of the IDIS-KS. This part involves:

- The *System Controller* that handles the user query, by directing it to the appropriate module; either the *inference engine*, the *explanation facility* or the *library of past queries*.
- A *Rule Base* that incorporates the necessary expertise for deducing an answer to the specific user query, based on the data stored in the medical data base. The rules included

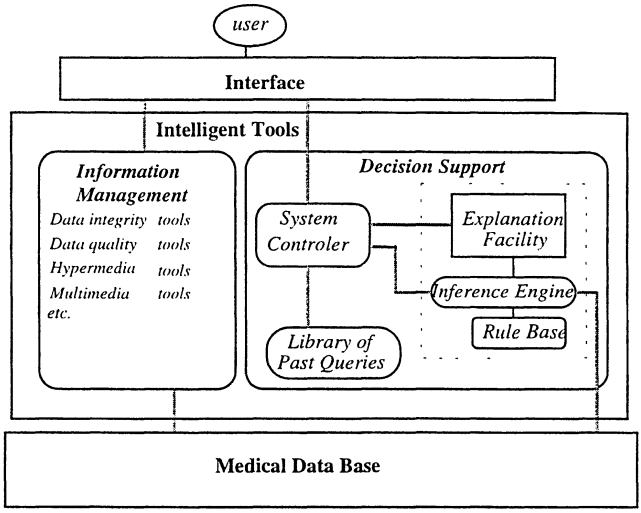

figure 3: The IDIS-KS Knowledge Server

will model the inference procedure of a human expert but will not contain drug specific knowledge about the medical substances; all necessary knowledge of the latter type will be retrieved from the MDB.

- An *inference engine* that is responsible for handling the above mentioned rule base, meaning inferences and rule firing.
- An *explanation facility*, that will be responsible for answering the *how* and *why* questions.
- A *library of past queries,* consisting of questions previously posed to the system. Any user query is matched against this library and if it has been posed earlier then the answer will be retrieved directly without the need of reconstructing it. This will improve the system performance and minimise unnecessary computation.

3. The *Interface* that provides a *user friendly graphical* environment in which the user interact with the IDS-KS. The interface will be easy to use and will not require previous computing experience from the end user. It will be able to adjust to the particular needs, interests and authorisation levels of the user. A number of interfaces will be developed to support the network connections to all platforms proposed above.

6. Simple Cases Drug Consultant

Currently, the above described decission support architecture has been applied to the development of an expert system that will assist the user, by providing a safe procedure to follow in order to supply medication in most common conditions . This system, called SCDC (Simple Cases Drug Consultant), has been developed as part of the Mermaid [8] Eurpean funded telemedicine project. The latter aims to the provision of multilingual medical emergency service around the world by using state of the art satellite and terrestrial communications to transfer the expertise to seafarers when necessary. SCDC is intented for use on board when communication with one of the land bases is considered unnecessary. It interracts with the user obtaining all the necessary input and then retreives from the database all the information required in order to provide him with the necessary advice and information concerning the drug treatment of the patient in need. It has been developed in

Prolog (LPA Prolog [9]) while all the information needed has been stored in a relational data base (Paradox [10]).

7. Conclusion

The technologies involved in this project are neither new nor experimental if examined on their own. What we believe to be of both scientific and practical interest is the combination of them that will enable the offering of high quality services to the medical community. The aim is to improve the quality of offered services in the area of Greece and be of valuable help to all interested parties.

As an extension of the above, a specialised Drug Information Centre (DIC) [7] can be founded for recording all drugs and medicines used in therapeutics mainly in Greece and for supporting the expert system, i.e. knowledge verification and maintenance. This center could also provide off-line access (by phone or fax) to users unable to consult IDIS-KS via a network connection offering services to a larger number of users.

8. References

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[8] MERMAID is the acronym for the project "Medical Emergency Through Telematics", sponsored by the EU programme TELEMATICS 2C, ref. no. HC1034.

[9] LPA Win Prolog is a trademark of Logic Programming Associates Ltd.

[10] PARADOX is a trademark of Borland International Inc.