QUESTION ANSWERING IN AN ORAL DIALOGUE SYSTEM

P. Nugues, C. Godéreaux, P.O. ElGuedj, and F. Cazenave

Institut des Sciences de la Matière et du Rayonnement
6, boulevard du Maréchal Juin
F-14050 CAEN, FRANCE

***Abstract*— In this paper we describe how a computer dictation system can answer certain questions from a physician. Using speech recognition, dictation systems can automatically generate medical reports. Our dictation system, DictaMed, models the medical entities using an object oriented representation. These entities are created along with the dictation when they are mentioned by the physician. The dictation system is complemented with a questioning module so that the physician can have access to the values of the previously created entities and possibly to supplementary information. The answer to a question is synthesized using a text–to–speech converter.**

I. INTRODUCTION

Computer dictation systems that automatically generate the text of medical reports are appearing [1, 2]. DictaMed [3, 4] is a dictation system aimed at generating reports of Holter ambulatory monitoring. It integrates an off-the-shelf speech recognition device: Voice Navigator II [5] and a text–to–speech converter. It is based on a modular architecture and features three Knowledge Sources (KSs) (Fig. 1). These knowledge sources correspond to syntax, semantics, and dialogue layers.

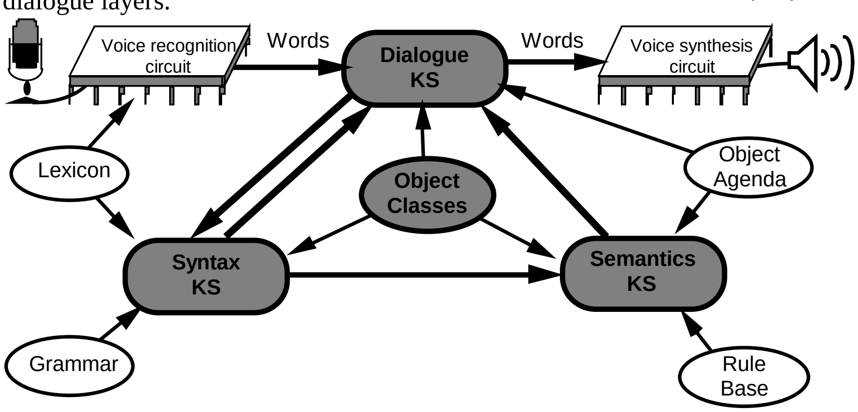

Fig. 1 The Knowledge Source Architecture

II. MEDICAL OBJECT CLASSES

The medical knowledge was represented using an object oriented form. This knowledge was structured into Themes, Subjects, and Attributes.

Themes map the structure of the report and represent its divisions. Themes are composed of related subjects which represent the medical concepts. Themes feature the agenda of the compulsory and optional subjects to be mentioned. For instance "Heart Waves" is one of the themes of the report and the subject "Rhythm" belongs to this theme (Fig. 2).

Subject objects represent the basic medical entities. They are qualified using attribute objects. The list of attributes of a specific subject is specified using a slot of subject objects. Another slot is the agenda of possible other subjects once a particular subject has been mentioned. Once a sentence is uttered by the physician, the corresponding subject and attributes are created.

Subject Rhythm, for instance, is implemented by the following structure:

```
rhythm(
  [descriptor, rhythm],
  [attributes, [speed, shape, balance],
  [otherSubjects,          [rhythmTroubles,
Pwaves, frequency, paceMaker]])
```

Attributes are used to qualify subjects. They notably feature the list of legal values. They also feature certain constraints that a specific given value may impose on other subjects. For instance the shape attribute (of subject rhythm) is implemented by the following structure:

```
shape(
  [descriptor, rhythm shape],
  [currentMessage,      "rhythm
shape is recorded"],
  [errorMessage,   sinusal   or
irregular rhythm],
  [valueDomain,       [sinusal,
irregular]],
  [constraints,       [sinusal,
[prohibited, rhythm troubles],
[compulsory, frequency]]]],
  [ruleName, shapeRule],
  [status, compulsory]])
```

The slot `constraints` indicates that if the rhythm is described as regular, it prohibits rhythm troubles and it makes the frequency compulsory.

Other representations [6] were designed using Frames and Qualifiers. Compared to it, Subjects and Attributes embody supplementary knowledge that can dynamically set links between subjects.

III. PARSING QUESTIONS

Using the object modeling, we have extended the syntax of our previous work [4] to parse certain interrogative forms. It enables the system to answer questions from the physician. The syntax is implemented using the Definite Clause Grammar formalism [7].

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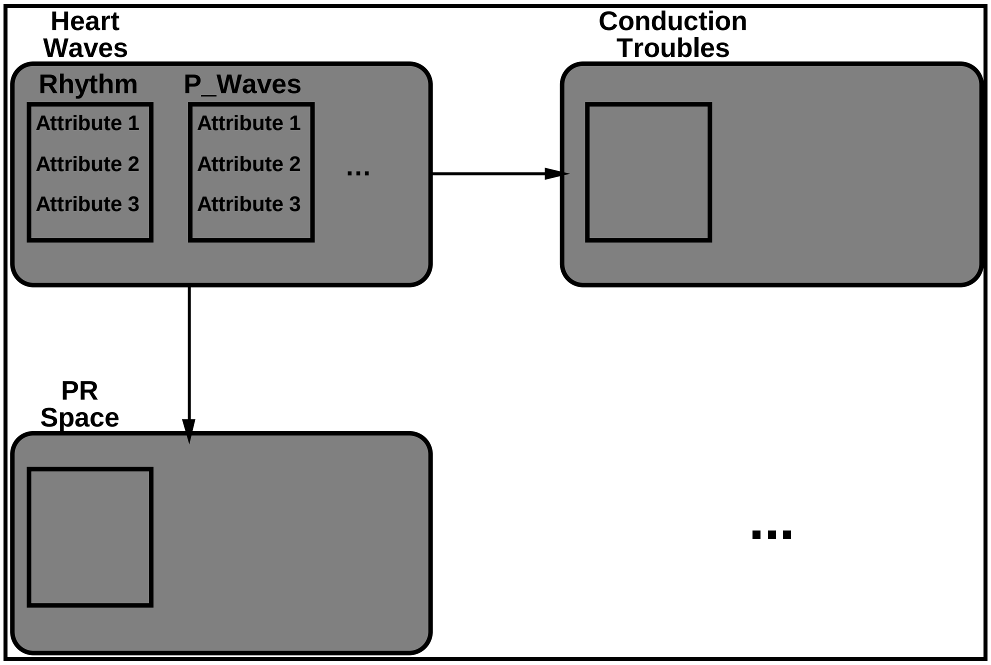

Fig 2. The Medical Objects

These questions correspond, for the moment, to five different types:

1. "How is «subject»?", for instance: "How is the rhythm?"
2. "How is «attribute» of «subject»?", for instance: "How is the speed of the rhythm?"
3. "Is «attribute» of «subject» «value»?", for instance: "Is the speed of the rhythm fast?"
4. "Is «subject» «value»?", for instance: "Is the rhythm fast?"
5. "What are the legal values for «subject»?", for instance: "What are the legal values for the rhythm?"

Once the question has been parsed, the system matches the mentioned objects to previously created objects. If the match fails, (if they were not previously created) the system warns that it can't answer. If there are objects corresponding to the question, the system builds an answer and mentions, according to the type of the question:

1. the value of all the instantiated attributes of the subject.
2. The value of the specified attribute.
3. If the value of the attribute is equal to the mentioned value.
4. If the value mentioned in the question is a member of the attributes values.
5. the values of slot `valueDomain` of the subject attributes.

The system answers the question using the speech synthesiser.

IV. CONCLUSION

We have decribed the implementation of questioning facilities in a dictation system. These facilities require an object modeling of the medical concepts in addition to a syntactic parsing of interrogative forms.

The object modeling enables to standardize the medical reports and to build versatile speech interfaces to provide the physician with more control over the computer.

For the moment questions are possible only on what the physician has previouly dictated in the current report. It can be envisioned that the questions could be on previous reports and possibly on all the patient data base. These kinds of dictation systems could then act as intelligent agents to alleviate the physician from certain tedious tasks.

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Correspondence: Pierre NUGUES
Institut des Sciences de la Matière et du Rayonnement
6, boulevard du Maréchal Juin,
F-14050 CAEN, FRANCE
Phone: 33-31-45-27-22

Fax: 33-31-45-27-60 E-mail: pnugues@ismra.ismra.fr