Accultran: Automated Interpretation of Clinical Encounters with Cultural Cues and Electronic Health Record Generation

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1 Approach

Accultran/Med or just Accultran (for Accurate, Acculturated Translator) is based, both philosophically and in terms of implementation, on Life-Code® NLP system that has been developed at A-Life Medical for coding and abstracting clinical documents. Automated Speech Recognition (ASR) is performed using the SpeechMagic™ system from Philips, which is currently available for twenty-three languages.

Many of the techniques employed in Accultran are established in the practice. Particularly we note the use of physician directed communication with yes/no patient responses, back-translation on the physician side, and the use of multiple choice answer selections for patient responses. Beyond this, we are exploring the use of CDA2 and SNOMED-CT as the interlingua for use in those portions of the encounter where clinical accuracy is essential, the use of semi-knowledge for recognizing when an encounter is potentially moving in directions where cross-cultural communications problems may arise, and the use of patient waiting time for patient directed acculturation based on patient complaint information collected upon presentation. The primary emphasis here will be on the use of CDA2 and SNOMED-CT.

Based on observations regarding physician and patient communication needs during a clinical encounter, we divide the clinical encounter into the following aspects: 1) establishing rapport; 2) chief complaint; 3) history; 4) review of systems; 5) physical examination; 6) diagnoses; 7) procedures; 8) medications; 9) instructions. Except for item 1, these all correspond to sections of the traditional clinical note or report and as such have extensive representations in CDA2 and SNOMED-CT. The Continuity of Care Document (CCD), a current effort to harmonize the ASTM and CDA2 standards in this realm, attempts to focus just on these elements using CDA2 representation capabilities. CDA2 is primarily declarative with some capabilities to represent contingencies. This is essentially what is needed for presenting information, but much of the encounter requires query and response.

The core of Accultran resides in the capability of the NLP engine to determine the appropriate context for each physician utterance and to appropriately process and route the content of the utterance. The overall communications flow for the system is illustrated in Figure 1, showing that upon receiving and processing an utterance from the physician, the NLP engine can choose one of several courses of action:

(1) Utterances that contain clinical questions or clinical statements for the patient to affirm or deny or instructions are: (a) converted to CDA2 and are (b) processed by a style sheet that produces the question/statement (c) first for physician validation and then (d) mapped to the patient language with, as needed, a request to affirm or deny.

(2) Utterances with content that cannot be converted to CDA2 are (a) routed to a general machine translation system, (b) optionally with back-translation and physician approval before (c) presentation to the patient.
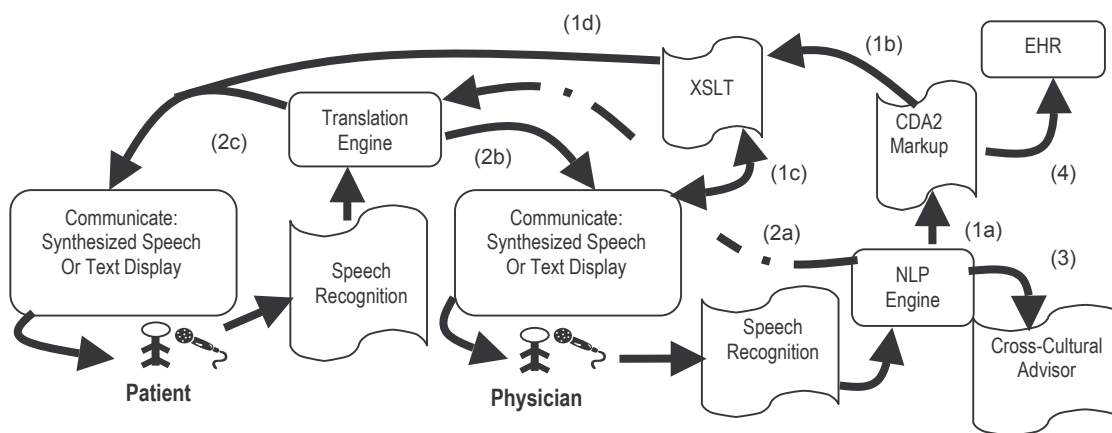
Figure 1: Framework for automated medical interpretation with cultural queues and EHR construction.

(3) Utterances that contain references to subject matter that is deemed culturally sensitive or subject to misunderstanding will trigger the Cross-Cultural Advisor.

(4) As the encounter progresses, the NLP engine appropriately directs information to the EHR via CDA2 for later physician review, and, as needed, revision.

The Cross-Cultural Advisor (CCA) module is a key feature. Technically it is based on the NLP engine's capability for recognizing and flagging clinical content that requires special attention beyond what the NLP system can independently provide. In this case, the flags are associated with warnings related to subject matter that is known to have either cultural sensitivities for patients in the target language group or that is difficult to translate into the target language. Options that the CCA could present to the physician for any particular flag would include warnings with explanation of the sensitivity, pre-formulated queries or informational presentations that are designed to mitigate any misunderstandings, or advise that a human interpreter be involved. In cases where the services of a human interpreter are called for, the CCA identified topic can be used to select, when available, an interpreter with training or skills appropriate to the case at hand. This can be particularly useful when Video Medical Interpretation

(VMI) capabilities are used and there is a pool of remote interpreters from which to select.

Triggering of the CCA is not simply a matter of recognizing key words in the discourse. This would lead to many spurious invocations of the CCA. As shown in Figure 1, the CCA is triggered only from elements of the physician's discourse. Although other trigger profiles can be defined, current triggers relate to specific patient conditions and circumstances, and to specific treatment modalities or some combination of the two. For example, a mention that the patient is pregnant would not in and of itself trigger the CCA. If, however, the patient is pregnant, is from a culture that attaches different significance and family roles and responsibilities with regard to child bearing, and the patient is experiencing fear or family pressure, or if the physician is anticipating the use of a procedure, say an epidural, that is not familiar in the patient's native culture, then the CCA would be triggered.

2 Demonstration Objectives

The initial and primary focus of our work has been mapping clinical speech to CDA2. The application of the system to medical interpretation grew out of this work due to the availability of SNOMED-CT (and other clinical nomenclatures, e.g. the International Classification of Diseases) in multiple languages. The CCA was a direct out-

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growth from the flagging facility that A-Life uses in its medical coding applications. Direct translation, i.e. that which is not via the CDA2/SNOMED-CT mapping, is accomplished using third-party software. Given this background and the current state of development, the demonstration will focus on the following objectives. Demonstration of:

Clinical speech to CDA2/SNOMED-CT.

Transforming CDA2/SNOMED-CT to query form.

Translating CDA2/SNOMED-CT.

Triggering the Cross-Cultural Advisor.

For a more thorough written treatment with examples and references, the reader is directed to the full paper. [Heinze, Turchin, Jagannathan: 2006]

References

Heinze DT, Turchin A, Jagannathan V. 2006. Automated Interpretation of Clinical Encounters with Cultural Cues and Electronic Health Record Generation. *Proceedings of the HLT/NAACL 2006 Workshop on Medical Speech Translation.* Brooklyn, New York.