Algorithm and Method for Automated Acquisition of Medical History

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Abstract - A successfully implemented algorithm and method of obtaining a medical history automatically from a patient is described. The main algorithm consists of a probe question/questionnaire, a coarse prediction algorithm, a fine prediction algorithm and a medical history generating system. The coarse prediction algorithm uses simple pattern matching against the medical knowledge database. The fine prediction algorithm uses a combination of pattern matching against the medical knowledge database, Bayesian inference where probability values so allow, and deep learning (both unsupervised and supervised as there is always human physician oversight of the system) where the number of patients is high enough to reasonably allow.

Keywords: Automated Medical History, Patient Computer Interview

In all areas of medicine, a medical history is the first step in arriving at a diagnosis and subsequently providing treatment to the patient. Traditionally, healthcare providers ask patients questions and in documenting the encounter generate a medical history. There are many problems with generating a medical history that is accurate, comprehensive and economical. Ramsey and colleagues [1] showed that of 134 primary care physicians studied, the physicians only asked 59% of what would be considered essential questions in order to obtain an accurate history from the patient. Tang and colleagues [2] showed that physicians in ambulatory practices spent one-fifth of their day writing. Thus there is a high cost in relatively expensive physician time being spent on charting.

As early as the 1960’s physicians were trying to use computers to solve the problems of generating a medical history that is accurate, comprehensive and economical [3]. Nonetheless, despite the advancements and improvements in computer technology over the decades, at the time of this writing, few physicians or other health care providers make use of automated medical history systems. Bachman in 2003[4] considers why physicians may not want to use computer-based interviewing, and in particular notes, “A computer program does not necessarily distinguish background symptoms from those leading to a visit to a physician. The physician, the patient, or the software needs to determine what is relevant.”

Much of the research in artificial intelligence in medical diagnosis assumes that there is an existing data set of input data. However, to the clinician seeing patients day after day the main issue is not making a diagnosis but the large amount of time and effort and skill that is required to obtain this input data from the patient.

We describe a successful algorithm and method of obtaining this input data, ie, obtaining a medical history from a patient, that has emerged from our pilot project in automated medical history generation. In 2015 110 patients in a general psychiatry clinic used our pilot automated system which in turn generated semi-automated and automated medical psychiatric histories which were compared to medical psychiatric histories generated conventionally, and the algorithm and method incrementally improved with each cohort of patients.

The main algorithm the system used was as follows:

1. Obtain previous medical history
2. Obtain probe question answer from patient “Why are you here?”
3. Obtain medical knowledge database related to #1 and #2
4. From coarse prediction algorithm and #1, #2 and #3, ask patient next question
5. If response to question from #4 was not appropriate try #4 again
6. From fine prediction algorithm ask patient questions and obtain patient data (weight, blood pressure, lab values, etc) related to likely diagnoses.
7. If answers to #6 indicate another diagnosis repeat again from #4
8. Generate structured medical history appropriate for visit and likely diagnosis.

The coarse prediction algorithm uses simple pattern matching against the medical knowledge database. The fine prediction algorithm uses a combination of pattern matching against the medical knowledge database, Bayesian inference where probability values so allow, and deep learning (both unsupervised and supervised as there is always human physician oversight of the system) where n (number of patients) is high enough to reasonably allow.

The system was implemented with a cloud architecture (Google App Engine) with physician portals and patient entry programs all running in web browsers independent of the underlying computer hardware. Due to local regulatory concerns no medical devices were directly interfaced to the system, but relied on the patient or the physician to input physical exam and lab values.

Future work includes comparing the time the physician must spend obtaining a medical history standardized to a certain level of quality and other time with the patient versus the time the physician needs to spend with the patient where an automated medical history is obtained, and comparing such comparisons against n (number of patients) for that diagnosis, with the expectation that time savings will increase as the system sees more patients of a given diagnosis.

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**References**


