Virtual Medical Doctor Interaction based on Transactional Analysis

Hamido FUJITA and Masaki KUREMATSU

Iwate Prefectural University, Iwate, Japan

http://www.fujita.soft.iwate-pu.ac.jp/
Medical innovations have become an important lever inquest of improving efficiency.

• The main purpose is to improve the efficiency so that more patients could receive treatment more quickly without reducing the quality of care
• Japan's health care system
  - High Demand ahead
  - Social service dependency on Volunteers
The proportion of the population 65 and over has doubled from 10% in 1985 to 20% in 2005, and is projected to be 30% in 2023 [2006, NIPSSR].

In June 2006, the Diet (Japanese Congress) passed a comprehensive package of reform to make the delivery system more efficient. First, the average length of stay in hospitals is to be decreased. To achieve this goal, the number of long term care (LTC) hospital beds will be reduced from the 2006 level of 380,000 to 150,000 by the end of fiscal year 2011 and converted to LTC Insurance facility beds and assisted living [Leflar, 2005].
The system proposed in this paper participates in helping physicians to manage the diagnosis procedure using the same knowledge that physicians have by copying (mimic) his/her style, mentality, diagnosis routines and medicine recipes.

Participates to provide a specific guidelines for elderly people From physiological prospective and healthcare ones.
• People often describe “Computers in Medicine” a computer program that helps physicians to make diagnoses.

• In Star Trek, for example, medical workers routinely point devices at injured crew members to determine instantly what is the problem and how serious is the damage.

• Medical practice is medical decision-making, so most applications of computers in health care are intended to have a direct or tangential effect on the quality of healthcare decisions.

• General societal concern about the influence of computers on interpersonal relationships and on job security, has naturally raised questions among health workers.
Types of Decisions

- **Diagnosis**: analyzing available data to determine the pathophysiologic explanation for a patient’s symptoms.

- **Diagnostic process**: deciding which questions to ask, tests to order, or procedures to perform and determining the value of the results relative to associated risks or financial costs.

- **Management decisions**: managing the patient through different steps of treatment and follow ups.

- The requirements for excellent decision-making fall into three principal categories: (1) accurate data, (2) pertinent **knowledge**, and (3) appropriate **problem-solving** skills.

- **Information overload**: The data about a case must be adequate for making an informed decision, but not excessive

- Precisely the same topics are pertinent to Decision Support Tools.
Historical Perspective

- The first articles dealing with this possibility appeared in the late 1950s and experimental prototypes appeared within a few years (1964).

**Leeds Abdominal Pain System**

- Starting in the late 1960s, F. T. deDombal and his associates at the University of Leeds studied the diagnostic process and developed computer-based decision aids using Bayesian probability theory.

- The Leeds abdominal pain system used *sensitivity, specificity, and disease-prevalence data* for various signs, symptoms, and test results to calculate, using Bayes’ theorem, the probability of *seven* possible explanations for acute abdominal pain (appendicitis (虫垂炎), diverticulitis (憩室炎), perforated ulcer (胃潰瘍) cholecystitis (胆囊炎), small-bowel obstruction (空腸憩室), pancreatitis (膵炎) and nonspecific abdominal pain (腹痛)).

  - http://www.iiharaijin.com/cpi_colitis0.html
  - http://allabout.co.jp/gs/medicalfood/closeup/CU20080509A/

- To keep the Bayesian computations manageable, the program made the assumptions of (1) conditional *independence of the findings* for the various diagnoses and (2) *mutual exclusivity* of the seven diagnoses.
Future of medical system

• The advent of managed health care in Japan, growing concerns about the cost and quality of patient care globally have altered the practice of medicine in profound ways.

• As healthcare organizations were undergoing radical change in the 1990s, computing technology was making an equally radical advance. The advent of the World Wide Web popularized computers in new ways. The Internet will bring decision-support systems designed for patient use directly into those patients’ homes and will provide more effective communication among all participants in the healthcare system.

• Considerations of whether specific components happen to use pattern-recognition methods, Bayesian reasoning, or AI techniques will become less important, as researchers create new approaches for combining different reasoning methods to meet the requirements of decision-making tasks.

• For the next generation of health-care workers, the use of information technology in most aspects of patient care probably will be taken for granted—much as it is in Star Trek.
A Structure for Clinical DSS cont.

- **Decision analysis:** adds to Bayesian reasoning the idea of explicit decisions and of utilities associated with the various outcomes that could occur in response to those decisions (*costs and benefits* of actions).

- **Artificial neural networks (ANNs):** are computer programs that perform classification, taking as input a set of findings that describe a given case and generating as output a set of numbers, where each output corresponds to the likelihood of a particular classification that could explain the findings.
  
  The program performs this function by propagating carefully calculated *weights* through a network of several layers of nodes.
  
  The values for the weights are determined in incremental fashion when a network is trained on a large collection of previously classified examples during a period of *supervised learning*.

- **Knowledge-based system:** is a program that symbolically encodes concepts derived from experts in a field—in a *knowledge base*—and that uses that knowledge base to provide the kind of problem analysis and advice that the expert might provide.
Mental Cloning based computing

To Establish a cognitive model that mimic a specific person: To model an assigned human: behavior and emotion in advance

Mental based generation of emotion represented through facial and speech synthesized in real-time (illusion).

To establish the best engagement with the human user
Personality Models

Estimate Emotion From Facial Expression
Estimate Emotion In Speech

Decide Emotion to Express
Decide Which phrase to Read out

Reading Out phrases with Emotion

Facial Expression Synthesis
Speech Synthesis

Documents
Phrases & Emotion
Framework for Emotion Synthesize

- emotion
- phrase

Synthesize
Facial expression
To express emotion

Synthesize Voice
To express emotion

Synchronize
Lip Sync
Fig. 4: The implemented system outline
• Mental View Ontology
  specify and reason on mental behavior of the patient:
  TypeFear:(Type_Age:20th, Type_Gender: male,
  Meta_Type_personality),
  pain (user): stereo type {disgust (attribute), (sad (attribute)),
  neutral(attribute)}, patient physiological stat( ego gram).

• Physical View Ontology
  Specify the physical status of the patient,
  Weight(real), temperature(real), tall, blood_pressure(x,y),
  BMI(real), BSA(real), IBW(real), previous diagnosis data(if any).

Telematics and Robotics for the Quality of Life of the Elderly, 28, 2009
Telematics and Robotics for the Quality of Life of the Elderly, 28, 2009

Mental View Ontology

Mental cloning

Articulation of the primitives of human university emotion through mental analysis, physiological observation of the patient user, user ego gram and etc.

Physical View Ontology

Physical Data of a patient
Blood Pressure, weight, height, BMI, IBW BSA, temperature, thermal face distribution, previous perception (if any)

Alignment and mapping of the above ontologies with semantical consistency

Web Ontology (OWL)
Semantic net search

Medical diagnosis based on MD: A in UMLS style, and represented in Semantic Net fashion

The 1st round of diagnosis presented to the patient

Diagonstician avatar

Cascade slices of hierarchal finding based on Joined ontology
The mental cloning based system components.
Transactional Analysis

Parent Ego state

CP
NP

Critical Parent Ego State

Nurturing Parent Ego state

Adult Ego State

Free Child Ego State

Child Ego state

C
AC

Adapted Child Ego State
Fig. 6: The TEG 2.0 based 60 Questioners outcome data
VDM self state

U: User self state
N: number of appearance

transition state based interaction
Fig. 10  the implementation of Doctor A self and patient self

Fig. 11  State Transition implementation of Fig. 9 and Table_2
• Mental cloning of the MD is presented. The articulation of the mental cloning in abstract form would be used to factorize the mental view articulated with knowledge token extracted from the mapping of the patient mental view and physical view.

• This work is been experimented for evaluation purposes.

We have built a technology to situation-ize the user mental states