VIRTUAL MEDICAL DOCTOR SYSTEMS
Status Progress Report on Virtual Medical Doctor System (VDS) Interaction Interface

Hamido Fujita, Jun Hakura and Masaki Kurematsu
Iwate Prefectural University, Iwate, 020-0193, Japan

Keywords: Emotional reasoning, Human user interaction, Intelligent interface, Facial analysis, Ego gram.

Abstract: Human computer Interaction based on emotional modelling is investigated and reported in this paper. Human personality is analyzed based on ego-gram analysis and accordingly human "SELF" emotional model is created. We have created as one part a computerized model which reflects a human user (in this paper Diagnostician model) impeded as a computer based reasoning model and through it, an emotional interaction between that model and the real human user is established. The interaction is based on a screen mask attached to manikin head resemble the diagnostician, that through it the system can act to speak (i.e., mimicking diagnostician) with the patient user. In this paper the interaction scenarios and reasoning of the virtual medical doctor or diagnostician are based on transactional analysis concept. We have implemented the system and empirically, examined it, as experiment in public space for revision and evaluation. The paper is reporting on the project outline, the usage of physiological issue in human reasoning through the virtual system is developed.

1 INTRODUCTION

Recently there have been extensive move to towards changing the way health care is delivered, financed and regulated (Smith, 2000) 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 (Mikkola, 2003). How to cope with a rise in the need for the elderly care services is a formidable issue facing all the industrialized countries.

Unfortunately, Japan's health care system has not been prepared enough to respond to the needs ahead. Particularly Japan's home care services have heavily been relying on voluntary labour of family members with little social services available. The proportion of the population 65 years 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

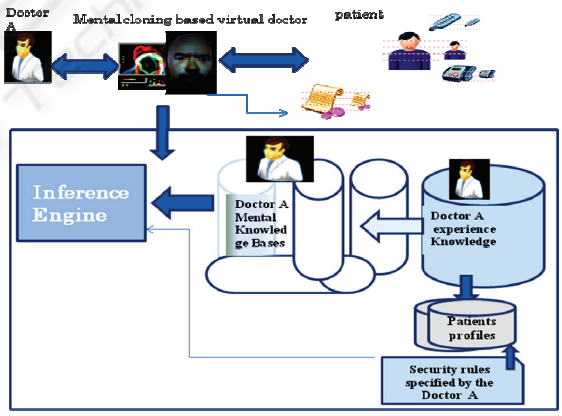


Figure 1: Simple outline of the VDS.

(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. It is not replacing the physicians but it would participate to utilize his/her knowledge for preliminary diagnosis

Fujita H., Hakura J. and Kurematsu M. (2010).
VIRTUAL MEDICAL DOCTOR SYSTEMS - Status Progress Report on Virtual Medical Doctor System (VDS) Interaction Interface.
In *Proceedings of the Third International Conference on Health Informatics*, pages 38-45
DOI: 10.5220/0002712000380045

and health care services for patient for efficiency purpose.

This paper contributes to present part of our experimental work on building a virtual system based or what we called as Virtual medical Doctor System (for short VDS) to act as medicinal diagnostician doctor, and interact with human patient. The Worldwide, the prevalence of diabetes is rising due to population growth, aging, urbanization, and increasing prevalence of obesity, and physical inactivity. We propose a system that can participate in the care processes inside a medical organization, by utilizing virtually the medical doctor experience and knowledge for health care services.

1.1 System Conceptual Outline

The VDS system is to work together with the corresponding human medical doctor. So the system (VDS) and the MD (Medical Doctor) are working together in comprehensive coherency; the former is complementary to the latter but not vice versa. The former is to diagnose outpatient 1st and classify these diagnosis into classes. *Simple* cases classes that the VDS would take conclusion and set the diagnosis procedure and accordingly take action (e.g., issue drugs to the patient). The overall procedure is supervised by the MD later on in a report. There are other cases which the system concludes to have the MD to participate in the final decision. In such cases, the system sends the diagnosis reports to the MD and provides an appointment to the patient in the hospital queue. The system reads the queue data at the management centre of the hospital reception. And assign the patient to the queue. If the Doctor found the assignment is appropriate (check mark *OK*) then the system learned that the decision is appropriate, however, by certain feedback from the doctor the system can learn from the doctor's feedback. We provide a window at the doctor office to fill a sheet of evaluation to enforce the learning procedure for the system. Such evaluation sheet would provide a learning mechanism to increase the reasoning procedure for the diagnosis. However such knowledge management would be based (*i.e., mimic*) on Medical Doctor A, therefore, it would be stored in knowledge management on the top of the management system. So when another doctor is doing the outpatient diagnosis then the profile of decision making related to that Doctor would be used (i.e., recalled). So there is a general diagnosis and on top of it there are diagnosis categorized on physicians actual practices.

The paper is showing the state of art in making a system that can interact with human user based on new concept named as mental cloning mentioned in (Fujita 2009). The cloning is based on analysis of human medical doctor (HMD). The analysis is projected using his/her observed styles as a person and also as expert in medical diagnosis related practices. So there are different style of categorized knowledge reflecting such representation and related reasoning.

As shown in Fig.1. The system would to create a virtual face (i.e., screen mask) of an actual doctor that through it the patient communicates with pre-assigned virtual version of that medical doctor.

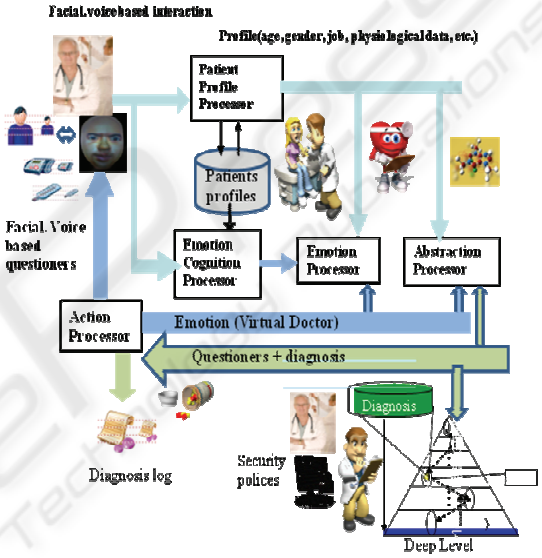


Figure 2: The VDS outline.

Physical doctor face is a mask copied and attached on manikin.

Inside it there is a projector that reflects the 3 dimensional generated images on the mask screen that reflects the actual facial real-time created images of the medical doctor namely, Doctor A (Fig. 1). These animated facial image synchronized with a spoken language in the same style of the actual physical doctor is created. The style mimics the actual doctor emotional expression as well his/her diagnosis style. Also the MD speaks in natural accent with emotions based on the patient mental mode, estimated by the patient profile (age, gender, ego data), and his/her situation automatically measured by data resembles (blood pressure, body weight, body temperature, and thermal analyzer). These devices (equipments) are assembled to a patient desk chair that the patient would sit on, and automatically these measurements are collected and transferred through serial connection to the virtual

doctor system. These data are all measured and send online to the VDS together with the mental status (situation) of the user (patient), with estimated ego state retrieved from the databases.
This system is been built by a support from Ministry of Interiors affairs and communications of Japan under SCOPE project. The security rules are specified through an interface by the hospital staff depends on patient portfolio related status.

We need to emphasis here that the diagnosis and treatment done by the VDS is based on the actual diagnosis and guidelines specified by the actual doctor based scenarios that we have collected in advance and specified in the system using Arden Syntax which is open standards and representation of medical knowledge. The Doctor A diagnosis guidelines are represented as a collection of medical logic modules (MLMs). Each MLM represents a single decision that is grouped into three categories: Maintenance, library, and knowledge. The maintenance and library categories describe the MLM's paramedic issues, keywords.

The knowledge category describes the logic of the MLM. We are investigating to use ASBRU for knowledge diagnosis based on Doctor A and generalizing them into diagnosis guidelines representation of schemata at various levels of details. This is the role of inference engine. We would explain briefly, this in Sec. 4. On more details, please refer to other paper in this proceedings elaborating on the inference issues.

2 VIRTUAL DOCTOR SYSTEM

In our project computer systems (machine) understand our emotion and interact with us based on internal psychological reasoning and type of information. The mind can be viewed as community of selves (Horowitz, 1985). A state of mind is a relatively coherent pattern a composite of diverse forms of experience and expression that appear almost simultaneously. These states of mind are accompanied by characteristic expressive behaviors, tone of voice, facial expression, and also other invariants, like type of color, type of current employment, and other invariants that collectively estimate the emotional state of the patient.

The objective of the system is to have hollow gram that interacts with the patient based on the mental cloning of the subject person through the hollow gram (i.e., HMD), and accordingly we can have the human user (patient) to interact with the system based on facial based analysis The whole system outline is shown in Fig.2.

The user age and gender is estimated using a tool developed with OKI Co. The tool can estimate the gender and the age of the user. Also, at the moment our system simultaneously has a touch panel that the patient can enter his/her other personality related information through icons based interface on a screen beside his/her desk. The system measures/collects the user personality based on a concept we called it universal templates (Fujita, 2008) that is used to estimate the user profile based on the collected data. The user information related to his/her, set of invariants that specified, by answering questionnaires related to his favourite colours, hobbies and type of employment (Hakura, 2009). The interaction is based on projection of the system (Medical Doctor) on a person onto oneself.
The reasoning between the patient and VDS, is based on projection on a patient onto doctor's self. From this prospective as the doctor is expertise person, she/he is projecting someone (i.e., patient) onto him/her self, bounded by the circular space, specified by the interaction space between the system (VDS) and the patient. It is a reflective interaction based on projection between the subject (patient) and the object is (VDS), by sharing the experience of the system projected into the patient related states. For that purpose, we have used modular approach. Emotional module, inference module and other modules that all synchronously, are interacting with the user based on patient projection for diagnosis purposes. We have psychologically cloned the user main "self", based on the user physiological analysis, and modelling. Mental cloning (Fujita, 2009) is aconcept specifying the type of harmony and the connection between the subject user mentality and other object. The subject of the user type mentality purposes specify the type of engagement that the object should have for successful interaction. The specialization of such engagement; in the context of mental cloning typifies the style of mental reasoning in the object (VDS) as the subject (patient) progresses and behaves.

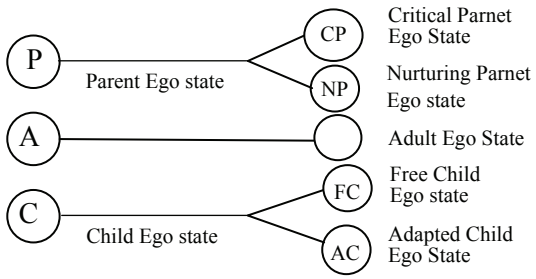


Figure 3: The five ego states.

The synchronic view (high degree of emotional representation to the environment) of self is also presented. The example of the mental user cloning we used was for Medical doctor mentality analysis and technical background on how to do diagnosis on people. These introjections are to specify the physiological view of both the work outcome and mentality of the object physical doctor.

2.1 Ego Gram based Transactional Analysis based Model

Transactional analysis is a development approach of self perception and its impact. The theory discovered first by (Eric Berne, 1971) and it stated that much can be discovered about an individual by analyzing the type of interactions (transactions) engaged in. TA (Transactional Analysis) suggested that we each had an *Inner Parent*, an *Inner Child*, and an *Inner Adult* personality parts that collectively determined our feelings, beliefs, and behaviour. The Transactional analysis life position is a function of the performance of a person and the attention received from other party (VDS System). The assumption is that all people want attention preferably positive (praise, encouragement). But if positive attention is not given, negative attention is selected. Self perception is an essential issue specifying attributes related to behaviour. Acceptance of self, ability to accept and relate to others in positive prospective is a desirable outcome. It is essential to foster a positive view of self for each user. (Dusay, 72) narrowed the large number of potential ego states to five: Nurturing Parent, Critical Parent, Adult, Adapted Child, and Natural Child. TA

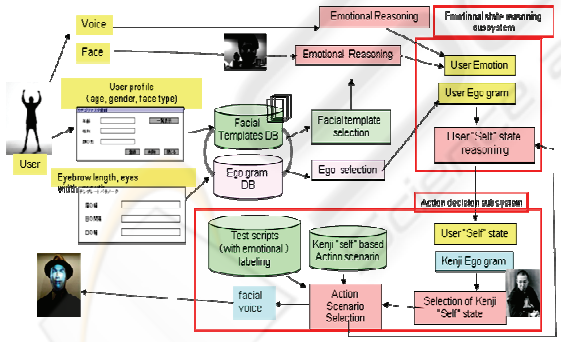


Figure 4: The system implementation outline.

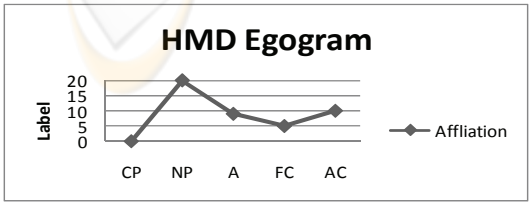


Figure 5: Ego gram of Doctor A.

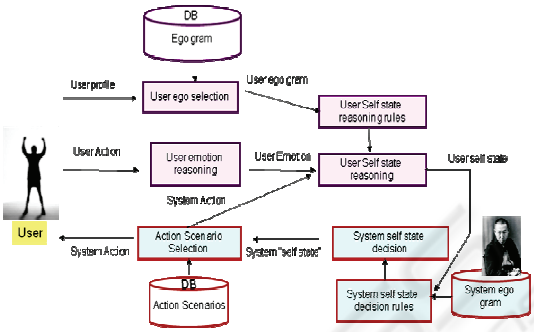


Figure 6: The mental cloning based system components.

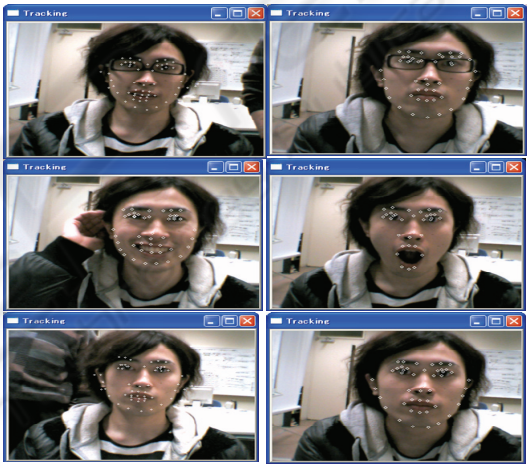
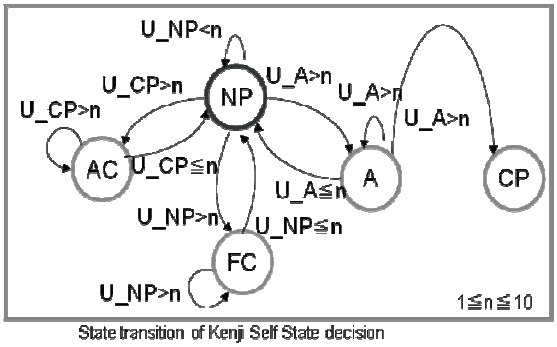


Figure 7: The facia extraction of user patient states.



State transition of Kenji Self State decision

MD self state

U: User (patient) self state

N: number of appearance

CP AC
NP FC
A A
FC AC

Figure 8: States transitions between patient and doctor.

conceptualizes personality in terms of five functional ego states: Critical Parent (CP), Nurturing Parent (NP), Adult (A), Free Child (FC), and Adapted Child (AC). These five ego states have been widely researched with varying degrees of scientific rigor. A number of researchers have attempted to demonstrate reliability and construct validity for these ego states. The Tokyo University Egogram is reportedly in use in Japan. Egogram is a sort of psychological scales theoretically based on Transactional Analysis. Tokyo University Egogram (TEG) published in 1984 was a questionnaire with reliability and validity. Since then, it has been widely used in various fields such as medical care, education, and industry. The second edition of TEG was published in 1993 after three years of basic studies. In this study, we investigated the use of TEG 2.0 for its personality application to predict the self of HMD and the patient user for best interaction based on the finding of the self through experimental analysis of the egogram using TEG2.0. The TA has been studied (Trautmann, 1981) for personality analysis, reflected in the TEG system for studying human personality.

As specified by Berne and modified by (Dusay, 1982) the five ego states are as below:

1. A nurturing parent subself: supports care, attention, and positive reinforcement.
2. An evaluative parent subself; critic, pusher, it reflects the norms and values of the society and set up standards and measures.
3. A central organizing subself, who is the self that often works with the observer and act as the leader.
4. A good socialized adapted child subself. This is obedient, conforming child who tries to please authorities, and it lacks creativity.
5. A natural child sub self, creative, nonconforming, spontaneous and playful. (As shown in Fig.3.)

A state of mind is a relatively coherent pattern a composite of diverse forms of experience and expression that appear almost simultaneously. A survey has been carried out to collect data on Japanese subject persons of different gender (male, female), and different ages (children, adults and old age). Each person has entered their responses for questionnaires (TEG 2.0 based 60 questions).

The object doctor and subject patient users (in advance for database personality construct purposes) after entering the user profile information (gender, age range), would answer (response) to these 60 questions as Yes, Yes/No and No. The Scoring answers as specified by TEG would be 2, 1, and zero, respectively. The collected sum answer would represent their ego state as number. One example for Doctor A ego gram is shown as in Fig.5. The highest value would represent the best estimation of self state of that person as one of the any state in Fig.3. These ego grams for personality extraction for patient purposes are stored in database and indexed. There are five categories of age class and these are: Child (6 to 12) years, junior young (12 to 18), senior young (18~26), adult (26~45), senior adult (45~60), Old (61~). These categories are set according to the educational system and working structure in Japan. 1st category to be related to elementary school class, 2nd category is related to intermediate school and high school. The 3rd category is relative to university class and young inexperienced workers. The 4th category is related to middle class workers of different slices.

The 5th class is relative to experienced workers and advanced middle class. The last class is the old and retired class people. Such classifications reflect the relative social characteristics of people as general class reflecting each class personality and its relative characteristics as specific specialization on each class.

3 ACTION DECISON MODEL

Our system outline is as presented in Fig.4, and Fig.7. The patient user when visiting VDS is sitting on chair where there is touch panel beside him/her. The patinet enters information by clicking on check box, on his gender selection box and age class box. The system uses a generative program to comput the user personality using what we have called a universal template (Fujita, 2008). The user's face; using the active appearance technology (Fujita, 2007) is been the computation subject to compute and categorize the searching keys to localize the best estimation to select the best "fit" of the human user from the template data base for emotional based reasoning. The Templates data base is a collective database of samples data of categorized according to user personality type. Each template is a set of six emotions (sad, happy, disgust, surprise, angry, fear) as shown in Fig.7, and neutral (no emotion). These 7 types of face templates set are been categorized according the user gender key and age class key. The localization and detection of the user emotion is based a systematic estimation approach using OKI FSE V4, SDK (OKI). For the eyes centre there is one feature point for each eye. For the eyelids there are 5 feature points for each eye. For the eyebrows there are three points for each eyebrow. There are 8 feature points for the mouth and three feature points

for localizing the nose. Also, there are 12 feature points specifying the contour of the face from the ears down around. Using these feature points we can track the emotional feature of the human user based on the value difference between the tracked point and the labelling dictionary in the database specifying the best emotional estimation and the selection of the emotional state among the six Ekman universal emotional states (Fujita, 2009).

4 HCI FOR VDS SYSTEM

In this part we would discuss how to define and establish the "self" or internal mental mechanism through which the system (VDS), would use to interact with the mental self of the human user. We have used an experimental survey to collect data. Based on these collected data we have created the mental self.

The Doctor Ego gram has been studied and experimentally brought up using empirical analysis. Doctor A personality and his/her answer related to the TEG Questionnaires have been carried using an empirical study analysis and analytical based observations. This has been done by asking the doctor to fill and answer questions based on TEG 60 questionnaires, and defined in the same way as shown on Fig.5.

The action scenario between the patient and the VDS would be based on the styles and wordings that are used by the MD him/her self in actual and other diagnosis practices. This part is not yet reported here in this status report paper due to space. However the style would be related to looking to the issues from minutes things to larger parts, collecting the micro views and macro views in different prospective for analytical based reasoning. These collected images are analyzed and reasoned in VDS related to the style that the MD usually do during his routines diagnosis. As the MD is in nature is a Japanese character, so this also would be considered in the system reflecting the psychological and cultural side into the reasoning process. This conceptual interaction is based on transactional analysis as shown in Fig. 8, assuming that the style of communication between the user and VDS system is Rogerian style (based on Cal Rogers' work in psychology) which encourages the involved two parties in positive style of engagement based on empathic position assuming that they share to explore common ground related to medical diagnosis. As shown in Fig. 9 the state transition of VDS's self change due to emotion state change of the patient user. Fig. 7 observes the user emotion state by computing the change in the feature points, and accordingly MD system can estimate the emotion state of the patient and integrate it with in the diagnosis for inference with other observation extracted from the keywords. The system implementation is as shown in Fig.9 and Fg.10. That shows the snapshot of the system implementation.

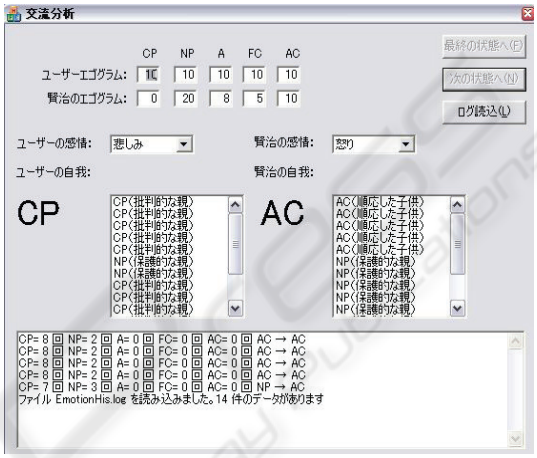


Figure 9: Implementation of *Doctor A self* and *patient self.*

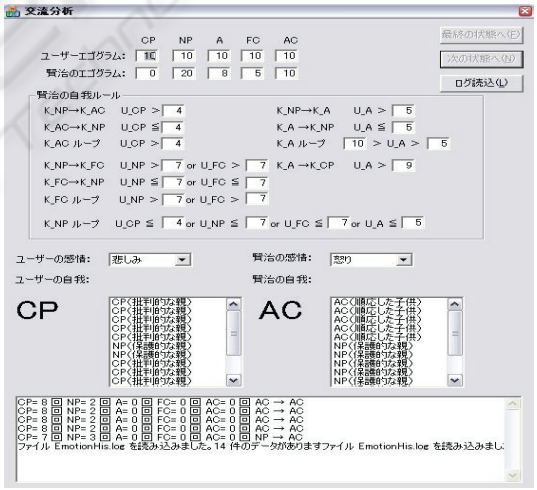


Figure 10: State Transition implementation of VDS.

The system observes to the user in cyclic time period of 10 sec margin for incremental type reasoning. VDS system is the initiative to talk with the user. The system estimate and compute the emotional state of the patient user while VDS system is talking, to collect if there is any change in the emotional state of the user and the appropriate keywords for inference purposes.. At the initial state the user emotional state is set as determined by the best match of that user with the best estimate for the

selected ego gram that set with the user personality. Then the user initial personality set is been selected. The system (i.e. VDS) would talk (with emotion) and check and collect if there is any change in the user emotion according to the rules shown below. If there is a change then Doctor A would record this state and select the appropriate action and related scenario to that state. The action can be represented by appropriate transaction state, selected among the 5 states mentioned in Fig. 3. The system should have a trace to all states so that it can return back to its original state when there is no specific emotional state change in the user emotions. If the patient user emotion state is neutral, this reflects that the user is adult state. If the user is happy state, then the user is nurturing parent state. If both the VDS system emotion state and the estimated patient user emotion state are the same, then the patient user emotion state is NP. If the estimated patient user emotion state is surprise then the user state is FC. If the estimated patient user emotion state is «angry» or «sad» or «disgust» (negative response) then the patient user emotion state is CP. The implementation is shown in Fig. 9 and Fig.10 and it is as follows:

Self state	Condition
K_NP→K_AC	U_CP＞4
K_AC→K_NP	U_CP≦4
K_AC loop	U_CP＞4
K_NP→K_FC	U_NP＞7 or U_FC>7
K_FC→K_NP	U_NP≦7 or U_FC≦7
K_FC loop	U_NP＞7 or U_FC>7
K_NP→K_A	U_A＞5
K_A →K_NP	U_A≦5
K_A loop	10＞U_A＞5
K_A →K_CP	U_A＞9
（Transition finish）	

※ K_CP→K_A and K_CP Loop not exist.

K_NP loop: U_CP≦4 or U_NP≦7 or U_FC≦7 or U_A≦5

We need to mention here due to space limitation we have not discussed the issue of voice (speak) generation and emotional extraction of voice(Kurematsu et.al 2009). The voice and face is been synchronized in real time and articulated to the generated scenario by the VDS according to CIGs.

5 REASONING SCENARIOS

The paper reports here part of our project outcome that is related to interaction between VDS avatar and Patient. The voice recognition issues is been also, discussed in (Fujita, 2009). The action scenario is to create a diagnosis based on the guidelines given by the Doctor A. Doctor A is a nominated Doctor which is the object system would mimic to interact with patient through VDS avatar. Implementing medical guidelines of Doctor A in active computer-based decision participates to enhance the best practices of medical services on behalf of Doctor A. Our system reported here briefly, participates to provide cognitive interaction between real patient and specialized doctor A (avatar) through computer interpretable guidelines (CIGs).

We have to represent various types of diagnosis guideline using formal representation. Consequently, acquire, verify and evaluate these formalized guidelines for daily routines diagnosis.

The system would be facilitated at hospital A where Doctor is working. So the system would use the computer interpretable guidelines (CIG) based on Doctor A as first diagnosis procedure to specify and categorize (classify) patients according to their status and profile. Please note that the classification and diagnosis is based on Doctor A cognitive interaction. The reasoning knowledge (eg. Doctor A methods and Doctor B methods) should be separated from domain knowledge (eg. laboratory tests, used drugs). Also the representation should support the use of standard data model and medical terminologies like HL7 UMLS (Tanaka, 2000)

We are using semantic net for representing the reasoning part. The domain knowledge is specified by automatic retrieval by establishing a link between the ontology and the patient database. This is reported in another paper in this conference.

6 CONCLUSIONS

This paper is reporting a progress status of our project related to mental cloning based concept on how to reason and represent human emotion in scientific way and use that emotion to reason with human user. We articulate realization to MD objective machine. The MD is usually a real person that based on interviews, we extract his personality that is to be used into the system and act on his behalf on mental basis using his/her routine diagnosis procedure. The MD views have been integrated into our representation in MD ego gram. Using this with other related information we create a system that can interact with the patient user based on Transaction analysis protocol. The system would be examined in Beta space at a hospital where that MD is working.

This would have people (patient users) interact with VDS system to experience his/her (i.e., MD) emotional transition to the MD created personality

and his/her transactional based analysis with patient users. The collected data of the evaluation would be examined to revise the VDS's personality and diagnosis knowledge. The personality is reflected from majority of answers that reflect how people can look to the VDS through his work and the gathered cognitive thinking on him/her. We think this approach may contribute to create the foundation of mental cloning based computing that can contribute to establish the best engagement and harmony between human and machine taking into consideration the human emotional recognition as computational mechanism in this interaction, for medical services.

The inference engine of the knowledge bases of the VDS knowledge hierarchy is briefly, reported in a companion paper in this proceedings. The prototype version of the system is to be used in medical practices in Kitamatuzono clinic, Morioka, Japan. The related statistical data on experimenting the work is to be reported in the near future.

ACKNOWLEDGEMENTS

This research is supported by the Ministry of Internal Affairs and Communications of Japan under the Strategic Information and Communications R&D Promotion Programme (SCOPE). We appreciate the supports provided by Medical Doctors in Iwate region Hospitals to mimic the diagnosis procedure into our system for testing purposes.

REFERENCES

Fujita, H., Hakura, J. Kurematsu, M. 2009 "*Intelligent human interface based on mental cloning-based software*" *International Journal on Knowledge-Based Systems, Elsevier,* 22 (3), pp. 216-234, April.

Pierre-Yves Oudeyer: 2003 «*The production and recognition of emotions in speech: features and algorithms*» , International Journal of Human Computer Interaction, Vol.59(1-2) pp.157-183.

Fujita, H., Hakura, J. Kurematsu, M. Chida, S. and Arakawa, Y. :2008 "*Empirical based Techniques for Human Cognitive Interaction Analysis: Universal Template Design*", the 7th New Trends in Software Methodologies, tools and Techniques (Proceedings of SoMeT_08), pp.257-277. IOS press, ISBN: 978-1-158603-916-5

Fujita, H., Hakura, J. Kurematsu, M.: 2007 "*Virtual Human Interaction based on Emotional Cognition",* Innovations 07, IEEE Computer Society, publication

Horowitz: 1988: *Introduction to Psychodynamics. A New Synthesis*: By Mardi J. Horowitz. *New York: Basic Books,* Inc.

David Lester 1993 «*On the disunity of the self: A systems theory of personality*», J. Current Psychology, *Springer New York*, Volume 12, Number 4/ Dec. pp312-325

Berne, E. 1961 *Transactional analysis in psychotherapy: A systematic individual and social psychiatry* London: Souvenir Press (Originally published in 1961 by N. Y.: Grove Press)

Dusay, J. M. 1972 *Egograms and the "constancy hypothesis*" Transactional Analysis Journal, 2, 37-42.

Stewart, I. 2001 *Ego states and the theory of theory: The strange case of the little professor* Transactional, Analysis Journal, 31, 133-147.

Trautmann, R. L. & Erskine, R. G. 1981 *Ego state analysis: A comparative view Transactional Analysis Journal*, 11, 178-185.

Woollams, S. & Brown, M. 1978 *Transactional Analysis: A modern and comprehensive text of TA theory and practice MI*: Huron Valley Institute Press.

J.Weizenbaum, 1966 *"ELIZA - A Computer Program for the Study of Natural Language Communication Between Man and Machine"*, Communications of the Association for Computing Machinery, Vol.9, pp.36-45.

Hakura, J., Kurematsu, M., Fujita, H., 2008 *An Exploration toward Emotion Estimation from Facial Expressions for Systems with Quasi-Personality*, International Journal of Circuits, Systems and Signal Processing, Vol. 1, No. 2, 137-144.

Hakura, J., Kurematsu, M., Fujita, H 2009 «*Facial Expression Invariants for Estimating Mental States of Person*» Frontiers in Artificial Intelligence and Application series, Volume 199, *New Trends in Software Methodologies, tools and Techniques (SoMeT_09),* pp.518-530, IOS press, ISBN: 978-1-60750-049-0.

Kurematsu, M., Ohashi, M. Kinoshita,O. Hakura, J. And Fujita, H., 2009: "*An Approach to implement Listeners Estimate Emotion in Speech*" Frontiers in Artificial Intelligence and application series, Volume 199, *New Trends in Software Methodologies, tools and Techniques (SoMeT_09),*.pp531-540, IOS press, ISBN: 978-1-60750-049-0.

OKI FSE Ver. 4, *A Face Recognition Middleware for Embedded System*: http://www.oki.com/en/press/2008/07/z08019e.html

Tanaka, M., Noguchi, M 2000: *Concept Retrieval of Medical Text using UMLS*, Japan Journal of Medical Informatics, Vol.20, pp.934-935.

Smith, 2000, *Reforming Markets in Health Care-An Economic Perspective*, Open University Press, Buckingham, 2000.]

Mikkola, 2003, *Hospital Pricing reform in the public health care system*- an empirical case study from Finland, International journal of Health Care Finance and Economics, 3 (4) 267-286.

NIPSSR, 2006; National Institute of Population and Social Security Research, "*Population Statistics of Japan*," 2006; Tokyo: NIPSSR.

Leflar,2005: Leflar, R.B and F. Iwata, "*Medical Error as Reportable Event, as Tort, as Crime*: A Transpacific Comparison," Widener Law Review 189, no.25 (2005).