Human Interaction based Reasoning using Ontology Alignment

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Abstract: - Human computer interaction is based on emotional modeling and physical views collectively. It has been investigated and reported in this paper. Two types of ontology have been presented to formalize a patient state: mental ontology reflecting the patient mental behaviour due to certain disorder and physical ontology reflecting the observed physical collected exhibited consequences of such disorder. These two types of ontology have been mapped and aligned using OWL-S and SWRL for reasoning purposes. We have constructed an integrated computerized model which reflects a human diagnostician as computer model and through it, an integrated interaction between that model and the real human user (patient) is utilized for 1st stage diagnosis purposes. The diagnostician knowledge has been utilized through UMLS for testing, and the integrated mapping of the two views been represented through OWL-S framework. The reasoning instantiation is done using OWL2 modeling implemened on Protege 4.

Key-Words: - Semantic Web, OWL, Medical diagnosis, knowledge based reasoning, cognitive model, human interaction

1 Introduction

An extensive attention is given towards changing the way health care is delivered, financed and regulated [13] 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 [8]. 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 labor of family members with little social services available. 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 [9].

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 [7]. 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 and health care services to patient for efficiency purpose.

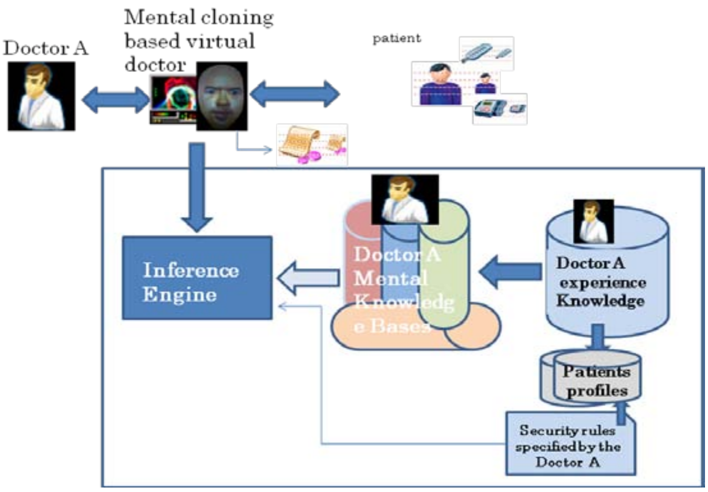

Fig. 1: Simple outline of the VDS.

This paper contributes to present part of our experimental work on building a virtual system based or what we called as Virtual doctor System (VDS) Fig.2, to act as a physical or medicinal doctor for diagnosis purposes. In other paper we have presented the outline of the interface, and in this complementary

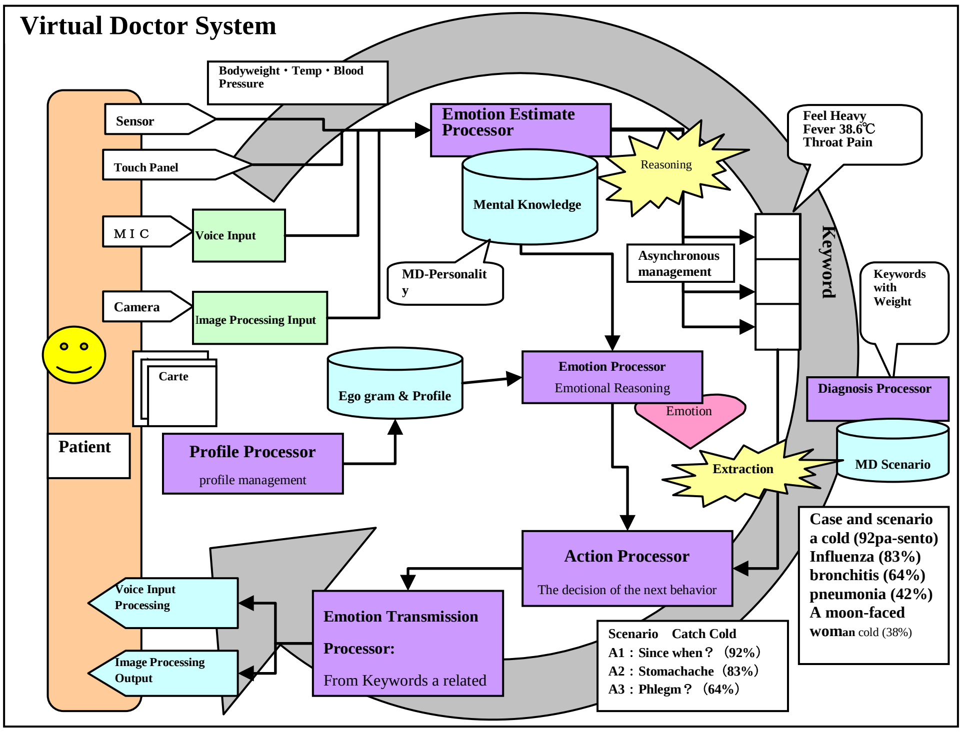

Fig. 2: The VDS System

part we are presenting the inference engine and the ontological based reasoning is to be shown in Sec.3.

Fig. 3: VD avatar

Fig. 4: VDS experiment style HCI

2 System Outline

The system we called here as VDS (Virtual Medical Doctor) (Fig.2) is to work together with the corresponding medical doctor that the system is mimicking. So the system (VDS) and the MD 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 according to a defined ontology shown in Fig.5. *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 medical doctor later on in a report for reference only. 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 outpatient in the hospital queue. The system reads the queue data at the management centre of the hospital reception. And assign the outpatient to the queue with a report. 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 in [2]. 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.2 and Fig.3. The system would 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. Physical doctor face is masked copied and attached on manikin (as shown in Fig 4). 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 and voices of the medical doctor namely, Doctor A (Fig. 4). These animated facial image synchronized with a spoken language in the same manner as the actual physical doctor is doing diagnosis practices in Japanese hospital. The style mimics the actual doctor emotional expression as well his/her diagnosis Case and scenario. Also, the MD would speak [6] in natural accent with emotions based on the outpatient mental mode, estimated by the patient profile class (age, gender, ego data), and his/her situation automatically measured by data resembled to classes in the physical ontology (blood pressure, body weight, body temperature, and thermal analyzer). The devices_read class (part of the physical ontology) to read outpatient physical data are all attached to chair with nearby touch panel. 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

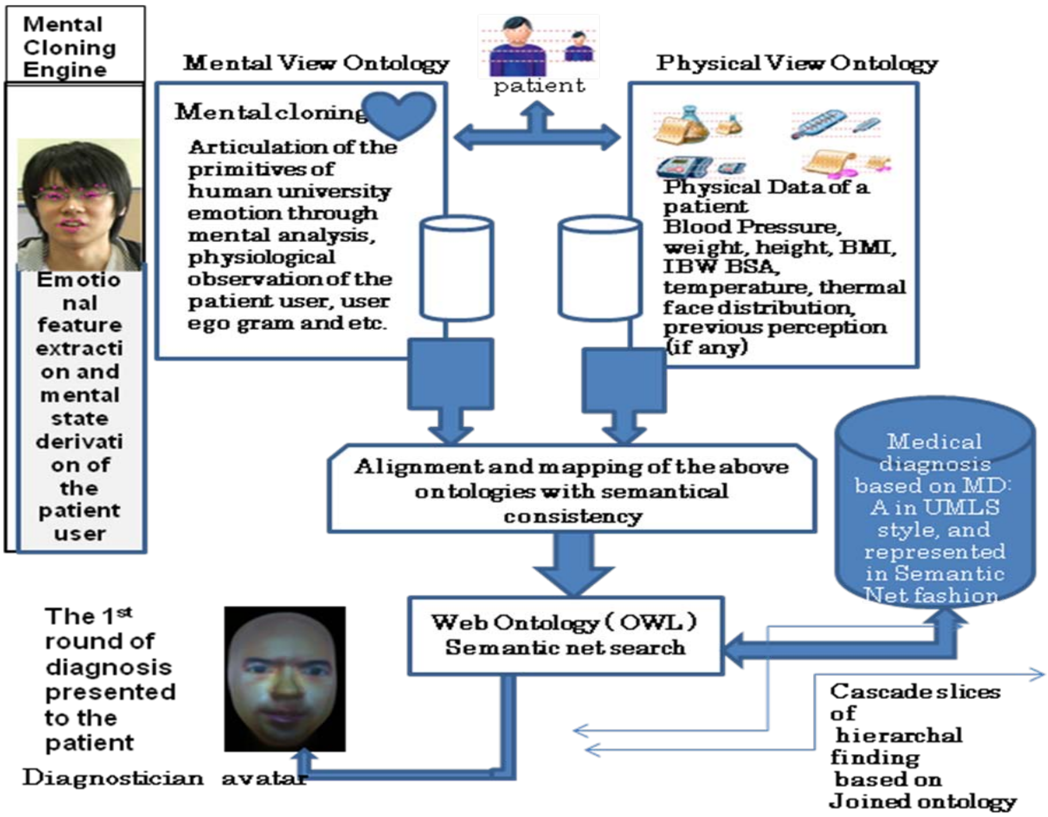

Fig. 5: System architecture of the inference engine

physical data are all measured and sent online to the VDS together with the mental status data (situation) of the user (outpatient), with estimated ego state retrieved from the databases. The touch panel monitor would be used to create an active interaction to enter data (response to diagnosis initiated by the VDS) by the outpatient according to the interoperability generated scenario by the VDS.

Using the touch panel as a means of communication between the VDS and the outpatient would overcome vocabulary problems initiated by the both communicating entities. The response of the VDS questions would be guided by the touch panel real-time generated images that the outpatient would click on to localize the diagnosis problems that he/she has while attending MD, in our case it would be VDS attendance based diagnosis.

The two classes (physical and mental) are aligned for reasoning purposes. The alignment is related to representation the both calsses in OWL2. Such alignment would create rules based on object porperties and individuals that are referenced to each class, and aligned for reasoning purposes.

3 Reasoning based on Semantic net

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 [6]. However, the voice recognition of the outpatient is considered as responses yes/no voice recognition classes and touch panel monitor response classes. 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 interoperability based decision participation 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 virtual version of specialized doctor A (avatar) using computer interpretable guidelines (CIGs) represented by semantic web technology. The contextualization of the two ontologies specified namely, the mental ontology and physical ontology annotated mapping alignment, that produce annotated search profiling in the medical knowledge base compiled on semantic net with vocabularies and classification used in patient diagnosis. The combined usage of the two ontologies is intended (Fig. 5) to derive semantically appropriate references to the patient's status and correspondingly the appropriate concluded aligned key words for relative diagnosis search. The diagnosis retrieval from the knowledge base would be related to the specialization of the patient case through the combined ontology. This in turn would lead to derive the validated correspondence related to patient condition.

We define the structure of classes that are to be used in the hospital *Class patient*: as the class that specify all types of patient in hospital class and can be attributed by their: *Unique assigned number*. The number is a structure representing a form that store the profile of that patient and retrieve it when necessary, and updates its content. This code represents the hierarchy of the data structure of patient ID.

The patient ID file would have information related to the, personal information, like name, gender, age, employment type, tallness, address, marital status, special information and other type of personal related medical information. This represents the *patient module* that would have related information to the *mental state* of that patient, his/her *physiological* state definition shown in Fig. 5 as ego gram and profile database [2]. This would establish a template that also stored as part of the patient module structure. Such Templates is related to the mental cloning[4] aspects: The user ego gram, his/her universal templates, and six basic templates of Ekman emotion and the neutral state (no emotion recognized state) [3]. As part of the language issues we have defined other modes that are needed during the diagnosis procedure. These types of emotional modes are related to the effect produced due to a certain combination appearance that the patient would have as a result of disorder or sickness of different cause or nature. These states estimated appearance can be specified as pain(x), x would be a percentage values that to be extracted from the combination of other observed cognitive state. We have six primitives' cognitive states. {*Happy, sad, disgust, fear, surprise, anger*}. Each state can be attributed with a value representing rates among: *high, low medium*. These cognitive states are primitive's states, due to their characteristic nature to express human emotion, universally. Albeit, the degree of exposing these states are different among people due to several factors. The digestion of these primitive values and localization is verified using the touch panel monitor and/or responding to questions from the VDS as yes/no voice by outpatient. These cognitive states values can be predicated and estimated (i.e., computed) based on specialization and symmetrical projection through people characteristic, observed through other disciplinary, like `Type_Age, Type_Gender, Type_Ego-gram` and so [5]. In this paper, we call these as *stereo data* as typed Meta data related to complex representation for emotional states. For example: `TypeFear:(Type_Age:20th,Type_Gender: male,Meta_Type_perosnality)`. This is a stereo type (i.e., class definition) on Class:fear be characterized. For sickness related issues, the pain (user) can be a stereo type of a combination of *{disgust (medium), (sad (low)), neutral}*. The combinations of the emotional related states can be extracted in real-time from the frame video collected from user images labeled on the spoken sentences that VD articulates to present his/her condition, synthesized by the touch panel input coordinated by emotion transmission processor (Fig.5).

Also, articulation representation through the outpatient's voice to extract user physical status or/and mental status in spoken language is considered. This time the spoken language is Japanese. The spoken language is arbitrary set of sound's words (sound of spoken words). The sound is a stereotype collecting the emotional feature of the patient (i.e., user) measured by pitch and power [6]. For example the strep throat with nasal secretions or sore throat due to viral infection would have a certain pattern of pitch and power sounds characterize the throat soaring and depth of infection. The facial and related situational information collected by the system would reflect the status of the patient observed appearance. Here, is the stereotype of the emotion of the user. So the patient status is a combination of the pair: `{StereoType_Voice(pitch, power), Stereotype_ (Face(happy, sad,..), situation (gender(Boolean), temperature(integer), blood pressure(integer,integer), BMI(integer))}.`

The Face(…) class definition would participate to reason for example to the type of headache The pain type is; Pain (burning, steady, sharp) can be collected from the articulation of the six primitives of face emotion. However, particular expressions to painful stimulation occurred with regularity and that the durations of these expressions changed differentially with age [16].

These two different ontology stereotypes information represent the mental cloning of the user for reasoning purpose. The wording (key word extraction by the mapping alignment between the two view schemata related to the two ontologies), are to be concluded by the system. These wording would construct the situation related abstraction useful to be articulated to construct the schema needed to establish the conceptual view of the user diagnostic situation. Words collected from patient through different means as shown in Fig.2, and conceptualized. For example Headache; as a concept is conceptualized into mental view (facial, sound, touch panel..), and physical view (temperature, blood pressure, BMI, touch panel). Each view would have a set of condition and assertion to be fulfilled collectively as assertions. Next section explains the ontology behind these views and the class annotation representation to represent for reasoning purpose. The observed behavior represented by these merged two views, are temporal order related situational representation. It is sequent cascade incremental reasoning, based on regenerative schema at the functional correspondence mapping. It is cyclic iterative reasoning based on the ontology base reasoning for diagnosis. The 1st structure pattern would be used to collect the best response, and accordingly the related diagnosis pattern is fetched and customized with diagnostician template to readout, to the patient with emotion mimicking the MD namely A. The response from the patient would lead to another incremental schema that is semantically consistent with the previous schema with similar partial set semantically consistent fragmented diagnosis outcome, with extra key word, extracted from the patient response derived from patient performance due to the readout, role-act diagnosis initiated by the schema of the alignment of the two ontologies. The incremental schema generation from the mapping alignment constructed through the patient and computed by system due to the VDS generated scenarios derived from the semantic net, and shown in Fig. 5, is cascading and incremented schema type generation, in nature. This would provide structured interoperability through such integration. Medical diagnosis process is built by merging a set of fragments instances of the mental views instances with the corresponding physical views instances. These mappings are expressed with various relationships between classes in the two different ontology fragments, for machine executable medical diagnosis purposes for interoperability based VDS. The VDS final conclusion on the diagnosing situational reasoning process would also be part of the readout to validate the patient performance if he/she is satisfied with the outcome. This validation process based on patient observed behavior due to the diagnosis outcome (conclusion) is essential to help the patient be more interacted with the VDS on basis on collective engagement for best practices. All diagnosis reports are classified into categories, as high risk, medium risk and low risk. This is according to patient collected observations.

Above we have expressed the stereotype emotion, and below we integrate it with the stereotype voice. The stereotypes voice is also used by the VDS to express the question and related responses for information extraction from the patient user. The VDS doctor would express these synchronized stereo types using avatar which is 3D generated graphics and synchronized voice sounds as shown in Fig. 2 and Fig.3. The 1st response would be presented through the avatar using the representation of the stereotypes (emotion and voice) mentioned above. Then the collected information for the patient user is also represented in the next cycle of diagnosis hierarchy, for another round of reasoning in the search engine. The information knowledge is represented as semantic net and based on the stereotype representation (as shown in next section). The domain knowledge is specified by automatic retrieval in establishing a link between the ontology and the patient database, as shown in Fig.2.

The word selection is specified through the keywords. The schemata outline (as above) would construct the conceptual schema that would be used to do search in the semantic net based on the situational abstraction articulated on the two views, namely the mental and physical views.

The semantic net is constructed based on Object Web ontology (OWL). The data base is constructed such that the diagnosis would be articulated on structural hierarchy. For example pain, with fever, specify the diagnosis of pain fever class hierarchy, then pain would be specified as location by the user answer through the touch panel interaction.

We formalized OWL based reasoning of the system using these two types of ontology, to establish the semantic relation between procedures and entities among the mapped ontologies based on the previously explained stereotype views. We align the properties of physical diagnosis specified by the medical doctor with those related to cognitive reasoning based on the patient mental cloning articulation [2]. Features expressed by stereotype Meta data definition are used to make such alignment. The mapping is an abstraction that encapsulate the features (properties) related to certain abstraction in an ontology and reflect or map that feature into other ontology such that to qualify the related features through such mappings. This semantic level mapping is based on conceptual schema on each ontology. The mapping feature would provide coordination among different schema such that to establish semantic correspondence for reasoning purposes, in semantic web bases reasoning fashion. This would enhance and smooth the interoperability on service through different schema reflected on different type ontologies. As shown in Fig.2 and Fig.5., This mapping is incremental process as the patient produce new schema and also the VDS consume this schema to produce another request by which the patient user would correspond to produce another schemata to be correspondingly, consumed again by the diagnostician (the system). This procedure is recalled based on mutual induction mapping discovery through conceptual schemata.

This is incremental indexing schema because the process is qualitative driven by the diagnostician. It represents incremental diagnostic refinement by including new collected purified information.

4 Implementation Aspects

Ontologies used in semantic web consist of hierarchical description of concepts and their properties in a domain (nest of concepts organized due to the nature of the situation instantiated from the integrated ontologies). Fig. 2 shows the components of system implementation. This section explains the implementation that is: formalizing the medical knowledge, mental knowledge of the MD, diagnosis knowledge of MD and user profile knowledge according to the mental ontology classes and physical ontology classes, as OWLS's XML documents. Individual axioms, facts based on OWL'XML syntax are represented. Axioms in the clinical knowledge documents containing facts about patient that to be matched due to rules. Facts are matched against XML rules to provide reasoning support so to provide interoperability (automatic reasoning) using semantic net. This can be provided using Protégé 4[20][21] to build the ontology on the OWL using OWL2 plugins. All knowledge bases on Fig. 2 marked and linked (i.e., annotated) to the semantic type marked due to physical ontology and mental ontology for reasoning (instantiation) using SWRL (semantic Web rule language). The RDF based instantiation is ABOX and the annotation objects are instances versus API.

The reasoned would resof the semantic types (e.g., HEADACHE <-> Catch_Cold; Catch_Cold is Semantic Type, and HEADACHE is RDF based keyword).

The benefit on using the ontologies as separate resources would provide great flexibility to the system in contrast to systems that implement the ontologies as part of the application. The ontologies are OWL RDF files in our context. The access to high level of ontologies using API based on OWL-API [24] and Protégé API. Ontology would define the service of medical diagnosis as service API. This service API uses and reason inside the serponse to question asserted in the ontology.

The ontologies are a collection of statements about concepts that can provide a service through query and inference based on semantic net.

In term of OWL-S [19], Web service is defined in the context of medical application as the system that provides diagnosis to patient user as a service based on process ontology defined by merging the two ontologies, namely the physical and mental ones explained in Fig. 5. The Semantic Web should enable users to locate, select, employ, compose, and monitor Web-based services automatically.

The system provides a service based on specific input to search patient condition through semantic web based on OWL's XML representation in OWL-S. This is automatic web discovery that can provide a particular service for medical diagnosis discovery. Diagnosis of medical doctors as provider of a diagnosis service to patient is presented in OWL-S markup services. Ontology-enhanced search engine is used to locate the appropriate service automatically. So OWL-S enables declarative repository of services properties to be used for automatic service discovery. Program can invoke web service by another program or agent. Execution of web service is a sort of a collection of remote procedure calls. An OWL-S markup Web service provides a declarative computer-interpretable API. Software agent is to interpret this markup to understand what input is necessary to invoke the service and what information will be returned. The service profile through the usage of OWL subclasses would create a representation of medical services. The definition of the services as stated by the OWL-S[19] would be specified as below:

(1) The medical entity provides the service. In our case it is a typical hospital for outpatient, namely "Matsuzono_Clinic".

(2) The function the service computes: Diagnosis of Outpatient based of Doctor_named_A. The input is patient medical records, defined by the patient ontology. The output generated defined by the MD ontology. The preconditions are specified as valid patientCondition:
Valid_Insurance_policy,Valid_Age,
Valid_with_specific_medical_records. These are the preconditions that need to be checked by the system to have the validity needed to provide the service to the patient user. The profile of service describing its feature, and its category to reflect the quality of the service, is named as grounding.

```
<owl:Class rdf:ID="Profile">
<rdfs:label>Profile</rdfs:label>
           <rdfs:subClassOf
       rdf:resource="&service;#Serv
       iceProfile" />
    <rdfs:comment>
      Definition of Profile
    </rdfs:comment>
  </owl:Class>
```

Clinical data are coded in XML: each document has: `typeID, ClasCode`, Clinical document structure of these document is based on physical and mental ontologies of Fig.5. Resources are represented with URI descriptor. RDF documents are a composition of statement representing; subject, predicate and object. RDF can be presented as directed graph where subject and object are nodes and predicates are edges. Subjects and predicates are URI resources. Objects are either URI or plain string called as literals. Clinical data are coded in XML: each document has: typeID, ClassCode.

For the patinet class:

There are three roles models to be provided by the VDS system that are distinct.

Properties represented in OWL categorize these roles.

(1) Observation role
(2) Patinet_evident_data role, and
(3) providing_diagnosis role.

Role (1) is related to observed issue on the patient like his face color. Therefore, these roles represented in OWL through object properties. Role (1)is represented as:

`Owl:ObjectPropoerty diagonize patient with domain Doctor_A n diagnosis class.`

The both classes would have *DataType Properties;*

```
hasCough_name domain CatchCold Range:
string
hasAch Domain:CatchCold Range:String
```

Object Propoerties:

```
hasAch  Domain:CatchCold    Range:
CatchCold     Non-Functional
PropertyhasAllSimilarSickness Domai
n:Sickness    Range:Patinet
owl:AllDifferentFrom has been set to
the both Patinet and Sickness classes.
hasCatchCold(?patinet1,Cough1)
The SWRL ( Semnatic Web Rule Language
express example can be:
    ^  hasCatchCold(?patinet2,?Cough
    2) ^ hasCouchname(?Cough1,?type1)
    ^hasSicknessName(?patinet2,?Couc
    h2) ^
    swrlb:equalIgnoreCase(?Couch1,?C
    ough2)
    ^hasFever(?patinet1,?fever1) ^
    hasFever(?Patinet2,?Fever2)
    ^swrlb:equalIgnoreCase(?Fever1,?
    Fever2)
    -->hasAllSimilarPatinet(?Patinet
    1,?Patinet2)
```

This rule is firing if Patinet1 and Patinet2 possesses at least one similar Sickness(same `Cough` & same `Fever`). Th Class of pain and related mental issues can be use inteh same manner presented above.

Deductive inference is used for reasoning and represented by description logic, like RACER [23]. The OWL axioms and class constructors as descriptive logic for explicit inference from medical knowledge base that been implemented using the RACER reasoning engine.

The ontology vocabulary in terms of OWL is defined by RDF. The ontology is hierarchical definition and representation of knowledge domain with relevant entities and relations. This is the language that would interpret the MD diagnosis profile and patient data through the merged ontology vocabulary, namely mental vocabulary and physical vocabulary. Our two typed ontologies are described in OWL-S. The description logic used in OWL is to classify resources (e.g. patient profile ego gram, pain_type and etc.) that defined in RDF documents. OWL has two main categories: Classes and properties. The SWRL API provides a deductive logic based mechanism to create and manipulate OWL knowledge base. API used by the SWRL editor in Protege4. Rules is been defined and applied to OWL database and composed of antecedent (body) (called as A-Box in RACER), and consequent (head) (called as T-Box). A Fever:-Headache→Immediate;

Painful_URGENT_if_Temp_is_39 then go to …

Loading these rules using SWRL editor in Protégé4 and execute them as well.

OWL API rules are to be executed by FACT++ which is Description Logic(DL) reasoner on Protégé 4, also may use external reasoner through OWL API with other type of available reasoner through DIG (Description login Implementation Group)[25]. A DIG compliant reasoner is a DL reasoner that provides a standard access interface enables the reasoner to be accessed over HTTP, using the DIG language. The DIG language is an XML based representation of ontological entities such as classes, properties, and individuals, and also axioms such as subclass axioms, disjoint axioms, and equivalent class axioms.

The interaction in our system is based on inquiry search scenarios through the ontology representation of both the physical and mental ontologies. Based on patient condition and 1st impression reasoning, the system would establish a set of antecedent variants' as search inquiry words in used by the diagnosis processor in Fig. 3 to knowledge discovery in the ontology related to emotion and in the ontology related to diagnosis, and select the best scenario or cascade of scenarios suitable as consequent in the directed graph based RDF network.

The scenarios handled by the scenario processor are decomposed as network of tasks representing the control flow of diagnosis scenarios and related ontology, namely the physical and mental ontologies. The OWL-S has been used in such representation to provide web services with reasoning support that deals with facts and rules annotated from RDF based medical documents. The three elements composing the service according to the OWL-S are: service profile, process model (how to use the service), and service grounding (how to access or invoke the service).

For example, there is a correspondence relation between the medical process integration “drugs” and “medical decisions” domains. Consequently, there is semantics alignment integration among the instances semantic selection between, process decision and process of selecting the best match instances of drug property that fit to the decision to be expressed to the patient. (Fig.2).

We envisage templates that can be used by the diagnostician for matching diagnosis use cases to the drug prescription databases impeded in the knowledge base. This would be a sub ontology derived from the aligned two ontologies, (mental and physical). We envisage using a sequence diagram with association rules to examine interactions arising in various patient scenarios to establish the validity of diagnosis procedure as approved by the diagnostician. Discovering association rules is an important data mining problem. For example patient who has running nose can be either allergenic side effect or a side effect of cold sickness. Therefore, the main purpose of implementing relationships in the knowledge base is by analyzing the data as reference during decision making.

MD doctor diagnosis routines, as well as the MD personality (mental view) are added to the action scenario related to diagnosis (Fi.g.2). All these knowledge based are to be represented as a concept in DL in structural formal way using the stereotype based views mentioned above. The reasoning would be reflected through what we called as diagnosis map: reflects the clustering of different knowledge map articulated through the mapping of the two previously mentioned views (mental and physical) shown in Fig.5.
Also, there is a correspondence to the patient pattern: behavioural pattern that is reflected by the mental view ontology along with the attributed values of the physical view. Recall that the physical view is values reflecting by the physical status of the patient. This all resembled in profile processor shown in Fig.2. The strategy of changing diagnostician (i.e., MD) routines would be affected by specified instances of patient observation, these related observation would be categorized in a region that to be confirmed by actual MD, like blood or else physical collected data analysis. In most cases MD chose from limited evoked set of drugs which comes up in their minds, given a certain health problem of a patient. This evoked service is influenced by MD mental states, background and other local parameters. MD usually does not consider all possible treatment options, but chose approximately among two to 5 different options reflected to his/her experiences. This is resembled by the Emotion Estimate processor in Fig.2.

The knowledge base diagnoses scenarios can be revised and updated based on new diagnosis scenarios and participate to revise this efficiency related issue. However, it is still to be approved by the MD in order to be used by the system. We currently are collecting these action scenarios from a hospital case study in Iwate region, in Japan and implement them in the above framework. We would report on this in another paper.

3 Conclusion

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 such realization to establish a virtual medical doctor for diagnosis purpose. The MD is a real person that based on interviews, we extract her/his personality that is to be used into the system and act on his/her behalf on mental basis using her/his routine diagnosis procedure (knowledge and scenarios). Using this with other related information we created a system that interacts 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. We have represented the patient mental view and physical view. We have aligned and mapped these two views to discover the best integrated correspondence that resulted in a set of key words that would be used in searching the best action scenario relative to patient case. The discovery is incremental and cascade. The implementation outline of our system is presented in this paper. All diagnosis knowledge of MD is stored in the knowledge base as semantic net using Protégé 4+OWL2 and the reasoner is based DIG [25] type. For testing purposes we are collecting cases studies through MD committee board established as part of this project consisting of 6 MDs. The system is under construction and to be installed in a hospital in Morioka city Iwate, Japan by 2010.

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