ONTOLOGY AND EXPERT SYSTEM BASED INTERVENTION, FOR PSYCHOLOGICAL CONSULTATION

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ABSTRACT: *"Stress" is mostly an invisible aspect of a human being. Yet some of the outcomes might be visible to the external world, as behavioral changes, attributed changes or symptoms of some physical ailments, such as headaches, insomnia, loose motion and etc. There is high potential, a healthy human can be a victim of stress, but the other side is, in Sri Lanka, we do have extremely limited amount of trained psychologists and psychiatrists. This will lead to a situation as such, per a consultant, excess amount of patients, which will make the informational overload for the consultants too much and ultimately making them emotionally fatigue and may cause to degrade the diagnosis quality. The intension of this paper is to see, how ICT based assistance can be utilized to introduce a process oriented mechanism, which will be capable in long run to control some aspects of these unforeseen problems.*

KEYWORDS: Internal-Self-Talk; Ontology; Pos Tagging; Cbt; Ocean Model, Expert System

INTRODUCTION

There is a limit that any individual can hold on. This limit might be exceeded due to the physical work pressure at your office or mental pressure caused by some unaddressed mental issue. Regardless, though it`s mental or physical there has to be a limit. Unlike, getting exposed to a pressured atmosphere for a short time, being exposed continuously for a significant time without any solution will make you a victim of chronic stress. This idea was initially presented by Yerkes and Dodson (as cited in Cooper, Cooper & Eaker, 1988), which is referred as Yerkes-Dodson law (1).

With the escalation of the cost of living, rising hopes, excessive promises to be fulfilled, too much of obligations and plenty of causes of this sort, will prompt you to earn as much as possible. Regardless of the life status, this applies in the same way from richest to the poorest. A poor person might suffer that his/her earning is inadequate to look after the entire family, and a richer may suffer, how my company can face the rivalry coming from other competitors or etc. Many forms of problems, but ultimately, makes your mind exhausted. Many think, for most of these problems, the solution is money, so they tempt to become earning machines, doing extra work, overtime, spending sleepless nights via sacrificing the time to be spent with your family members and loved ones.

It could not always has to be scarcity of money. Maybe a relationship broke up, failing from an exam, will also give you the same pain or even more. If you keep on hiding forever, without sharing the pain with someone trusted, this will again lead to long term suffering, which is again the starter of the chronic stress. Hence regardless of the type of the problem, final outcome would be continuous suffering. That`s why one`s it`s said, no one can escape from stress, only can get adapted to it and get it under controlled, than letting the stress control you. (2)

The other side of the problem is, in here at Sri Lanka we have very few medical practitioners specializing in psychiatry and psychology. (3) We do have even lesser amount of psychologists than psychiatrists (4).

As we discussed above, the environmental setting in Sri Lanka, has ample of causes to make an individual a victim of some form of stress, but unfortunately, we do not have the expertise and resources to treat them at the same pace. Healthier set of human beings are an inevitable asset to any country seeking rapid advancement. If the population is not mentally healthy, though there are physically healthy, value will be less, hence mentality is the big boss which governs all the physical activities.

So this problem is having two ends. Here the attempt is to tie those two ends with a reasonable IT based outcome, where the final result will be fruitful to all the stakeholders. Here the stakeholders would be the patients / clients from one end, and the psychologists, psychiatrists from the other end. Patients will be experiencing more comfortable and reliable medium to express their problem with full of liberty. This mechanism will also address the excessive privacy concerns of certain individuals. Some patients will be excessively shy or anxious, when they need to express their problem in front of the doctor. That problem will also be addressed via this approach to a certain extent, hence in here, client / patient has to deal with an inanimate machine. Problem of being noticed, which will lead to social stigma, also can be controlled with an extended development of this application, enabling to use from home via internet. Likewise, this will introduce bunch of benefits to the clients / patients

The other side will be, how consultants will be benefiting from this. Truly for them as well, there will be bunch of advantages such as assisting to maintain patient`s history in a more methodical manner, prevent the chances of misinterpretation of the information, also will assist for the continued follow up on regular patients. From the other end, this mechanism will integrate a series of dispersed information into one place, which will make the proper connectivity of the information, which make more sense to the consultant when making diagnosis about the mental disorder. Eventually, this will assist to get a good flavor about the problem of the patient and it will allow to commence a more focused and fruitful discussion with the patient.

Unlike, in providing medication to other types of ailments, diagnosis of the mental disorders are very tricky. Lot of attention to detail is required to address the real problem existing. Even though this has become unrealistic with the extremely minimal amount of consultants specializing in this domain. Normally, more than 35 minute has to be utilized with careful attention for a proper identification of the patient`s problem, but in current setting due to lack of resources this has become impractical.

Actually, it`s this vacuum existing will be creating the opportunity for this application. It`s intended to reduce the informational and emotional overload a consultant will be exposed to, via introduction of this system in place. This will ultimately lead to effective diagnosis of the diseases of the patients, which will cause benefits to both consultants as well as the patients.

Concept wise, this system is based on the idea of "internal-self-talk". This means the internal conversation, an individual will be having with his/her mentality. (5). Via this approach, you can take out a burning problem which is receding inside of an individual. Actually, this is the same thing which will happen, if you meet a doctor physically. You will express your issues to the doctor via talking, in hear it`s captured inform of text. Via writing to an inanimate machine,

less stress and more liberty can be attained than directly talking to a living human being, though how much of insured privacy protection is there.

As the secondary concept CBT (Cognitive Behavioral Therapy) is used. This is a practiced and proven to be successful therapeutic mechanism which can be used to segment, internal-self-talk into human thoughts, emotions, behaviors, physical reactions and etc.

As the final concept, OCEAN model is used, which could be used in determining the individuals` temperament. In psychiatry and psychology treatment should be individual specific. This can be attained via accurate personnel temperament analysis.

Eventually this is an ICT based mechanism binding, internal-self-talk, CBT segmentation and OCEAN based analysis together. The technical implementation of this will be discussed in forth coming sections.

LITERATURE UNDERPINNING

As we have discussed in the introduction section also, problem of stress is just like a hidden curse. Root causes for the stress could be numerous. One prominent issue would be unbearable workload, known as work intensification (6). The severity of the stress related disorders are so much as, those `re completely internal and difficult to explain to another person.(7). Few of the visible symptoms for some would be abnormal behaviors as nail biting, constant usage of toilets and many more. (8).When a human being is under stress, additional strength is required to fulfill a given task, that at the normal level. This situation is known as cognitive fatigue. (9).

If the situation seems stressful, the best thing is to prevent such situations or actions, which you will anticipate as a stressors for you (10). In otherwords some how, if you can live easily wthout taking things seriously, the problem of the stress can be tackled to a significant percentage, but practically sometimes it might not be possible at all. At a glance though it`s visible that the problem of stress is adversly affecting to an individual only, it`s not true. Due to stressed victims lots of effcective work hours are being lost. In Canada it`s estimated as nearly, $150billion worth loss. (11). without stopping from that limit, these losses are adversely affecting for the GDP (Gross Domestic Production) of a country as well. So occupational or whatever types of a stress has become a problem, which has a direct negative impact for the national economic growth of any country.

As mentioned by the greatest scientist Hans Selye, "stress is the rate of all wear and tear caused by life" (12). This statement will suggest that, stress is a silent killer within you. Though how healthier you`re, though how fit you`re via doing exercises and taking good meals, yet stress can make you a victim of cardio vascular disease. Though a person is not smoking, not drinking, yet if your mind is not calm, you`re not escaped. This situation will cause for, severe heart attacks. Other complications like, impotency, fear towards having sex, fear towards women, lack of sexual satisfaction, domestic violence will also result in if the victim is married. (13). Long term, constant high stress exposure is identified as chronic stress. Being a victim of chronic stress is very bad to your health.

So far we have evaluated the impact of stress in individual level as well as national level to the whole country. If we take Sri Lanka we do have a problem torn atmosphere. War which was prevailing for 30 years, tsunami tragedy, lack of resources and infrastructure has contributed to

intensify the problem of stress in large scale. A very good evidence for this would be "A new WHO report has placed Sri Lanka fourth among 172 countries in suicides with 28.8 deaths for every 100,000 people" (14). This is a solid evidence, which can portrait the criticality of this problem.

So far we have discussed with evidences, one side of this problem. The other burning issue would be lack of resources, specially the medical professionals specializing in this domain. As per the findings it`s revealed, in Sri Lanka we have excessively limited amount of psychiatrists in Sri Lanka – Leading to a ratio of 1:500,000 nearly. (15) One of the main cause for this is, most of the doctors who has gone for the overcease training in this sector has not returned back to Sri Lanka. (16). Also nearly it takes more than 8 years to produce a qualified psychiatrist, where the supply is excessivly less compared to the demand. (16). To overcome Sri Lanka from this devastating issue of stress, otherthan the psychiatrist, psychologist also can do a vast contribution. Psychologists are the profesisonals who`re specializing in theraputic processes for the overcoming of mental imbalances, rather than going for medicational aspects. Contribution of psycholosists could be sometimes more than compared to a psychiatrist in resolving this issue, but the worst case is, in Sri Lanka, the number of psychologists are small; figures indicate there are only about 20 psychologists (of varying specialties) working in the entire country. (4).

So far we have analyzed the problem of stress, impacts of it and possible causes for it with plenty of exaples. Next section we ought to analyze would be, what are the existing ICT based implementations avilable with a flavor of soothing the human mind. As a fact, it`s visible there are plenty of applications avilable. Few of them would be, BellyBio which teaches you to practice breathing exercises to release your stress.(17). Another prominent app would beWhatsMy3. Here, this will employ a validated set of questionnaires to get user`s input and a score will be derived. Provide advises based on scores. (18). Another would be MoodGym, which will be a web based self practicing tool to change your thinking pattern and to develop your self esteem. (19). Though there are many applications with similar flavour, yet an application which will generat a CBT report based on the internal-self-talk concepts and an application which merges CBT and OCEAN concepts together will not be avilable. Hence my research effort is identical and unique in this case.

Eventually, if we analyz the concepts based on my research, those would be, internal-self talk, CBT analysis and OCEAN model. Internal-self-talk would be the internal conversaton an individual wll be having with his/her mentality. This is totally natural and healthy. It is important to understand that this internal dialogue can influence our feelings and behaviors. (5)

Figure 1: Internal-Self-Talk

The second concept would be the CBT, which is also known as Cognetive Behavioral Therapy. This is an evidence based psychological treatment mechanism, with a proven success. This is a talking therapy that can help you manage your problems by changing the way you think and behave. This is a very effective approach used by many clincians. (20)
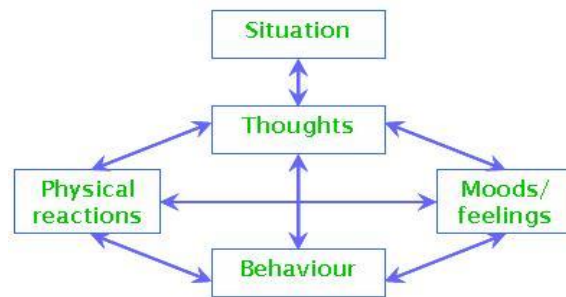

Figure 2: CBT

The final concept would be the OCEAN model, which is also reffered to as the Big 5 personnel traits assesing model which is familiar with most of the psychologists, and mainly used for the purpose of determining the temperament of a mindset. Before doing treatment, it would be very much beneficial to understand the temperament of a particular patient. (21)

Figure 3: OCEAN Model

Let`s see, how each of these concepts are interlinked via ICT, in the methodology section.

METHDOLOGY

Initially Natural Language Processing (NLP) mechanisms are applied to the captured thought stream to make it arranged as needed for the further processing. First captured sentences are delimited via a period and tokenized. These tokenized words are POS tagged and then sent through a POS tagged based pattern matching rule layer. These POS tag based pattern combinations are made by assessing variety of forms, which a user might express a though, emotion, behavior, physical reaction and an ANT (Automatic – Negative – Thought). Separate sets of POS tag based pattern layers are defined for emotions, thoughts, behaviors, physical reactions and etc. In a particular pattern layer introduced, it contains several POS tag based

5

pattern matching rules. For an example for behaviors pattern layer only, 12 POS tag based patterns are introduced.

All these possible POS tagged patterns are derived via conducting comprehensive analysis on the possible lexical forms a thought, emotion, physical reaction or a behavior can be expressed. The continuous assistance of the psychologists and psychiatrists are utilized in creation of these pattern matching rule sets. Altogether likewise 55 POS tag based pattern combinations are derived

```
String assignmentMode="";
String valSentence="";
fworder=worder;

rslt=thoughtAnalyzer_1(fpostagger);
if(rslt!=1)
rslt=thoughtAnalyzer_2(fpostagger);
if(rslt!=1)
rslt=thoughtAnalyzer_3(fpostagger);
if(rslt!=1)
rslt=thoughtAnalyzer_4(fpostagger);
if(rslt!=1)
rslt=thoughtAnalyzer_5(fpostagger);
```

Figure 4: POS Tag based rules for thoughts

```
*                    Rule -#01 I [PRP] 'am [VBP] willing [JJ] to
*                               I [PRP] ` am [VBP] happy [JJ] to
***************************************************************
***************************************************************
* ***********************************************************
*/
public int thoughtAnalyzer_1(ArrayList<String> tags)
  regionX=0;
  regionY=0;
  conditionMet=0;
  abs=false;
  ontoCheck=false;

  if (!(tags.contains("MD")) ||(tags.contains("VBG")))
       {
             if((tags.contains("VBP"))||(tags.contains("VB"))
               {
                    if (!((fworder.contains("have"))||(fword
                    {
```

Figure 5: Part of POS Tag based tule body

If a particular sentence captured from the internal-self-talk, satisfied a given POS tag based pattern, then it will be sent to a specially arranged ontology. Protégé is used in creation of these ontologies. 5 separate ontologies are created for the 5 sections of the CBT. Again contiguous support from the psychologists are utilized in creating these ontologies.

SPARQL is used to query from the respective ontology to see, if there is any relevant significance existing in the sentence passed from the POS tagged rule layer, as an emotion, thought, behavior, ANT or physical reaction.
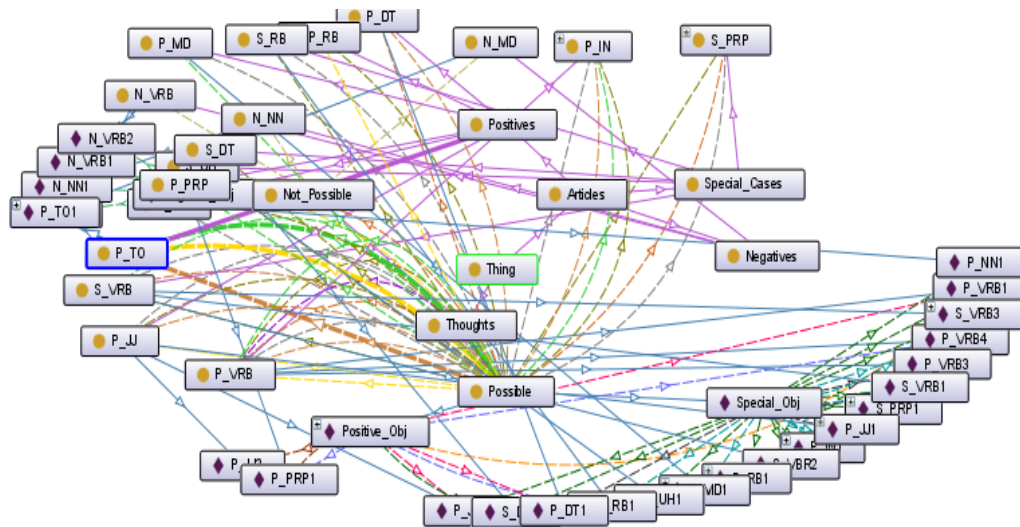

Figure 6: Ontology created for thoughts

```java
public  ArrayList<String> locatePossible_adjectives ()
{
        ArrayList<String> fvalues=new ArrayList<String>();
        String qry="prefix rdf:      <http://www.w3.org/1999/02/22-rdf-syntax-ns#>" +
            "prefix thoughts:  <http://thoughts.owl#>"        +
            "SELECT ?x "
        +  "WHERE "
        +   "{"
        +       "?person    thoughts:status 'yes' ."
        +       "?person    thoughts:possible_adjectives ?isu."
        +       "?isu       thoughts:values ?x."


        +  "}";
```

Figure 7: SPARQL query for thoughts

Next important sections is the practical implementation of the OCEAN model for the effective personnel trait and temperament analysis, which will be required for the personalized treatments.

This is implemented with the assistance of the Drools rule engine. Keywords depicting the features of the sections of the OCEAN model is captured as much as possible. For an example person with Agreeableness positive is "kind", "faithful", "innocent" and etc. Henceforth, these are introduced as the rule sets in the Drools rule engine. Eventually a relevancy checking algorithm is proposed to determine, how much a particular sentence is relevant to a section in the OCEAN model. With the final aggregation of the total relevancy checks, a percentage value was proposed, depicting the composition of the various aspects of the OCEAN model, within the temperament of the individual.

Figure 8: Drools Rule Engine

Drools rule engine is used inform of an expert system. Required knowledge is included in form of drl files. These knowledge representing various characteristics are captured from knowledge transfer sessions had with experts as well as via online research materials

RESULTS AND DISCUSSION

This system is initially developed using WEKA based machine learning principals. Once the development is done, this was given to experts for the testing. System was given to 5 consultant psychaistrists and to 2 clinical psychologists. Once the internal –self-talk was entered and when the CBT analysis was conducted, most of them `re not happy with the final accuracy rates. As an improving mechanisms, classifiers are changed from Naïve Bayers to SVM and later ensembling approaches like AdaBoost and Stacking was also used. Yet the experts `re not happy with the finalized results.

Hence this is a situation, that we are dealing with human beings, they tempt to say, that their has to be a significant accuracy. This comments made to do a drastic change in the direction of the research. Finally, machine learning approach was given up. After having severl discussions with technical and medical experts, finally, a POS taggin based rule layers are defined. Hencefoth to do more sensitive segmenting as per the requirements of the CBT, a pos tag based ontologies are created with the help of Protégé tool.

For the implementation of the OCEAN model, a full rule based expert system is introduced via the help of Drools rule engine. With the blend of these two approaches, system was given again for the evaluations. 5 consultant psychiatrists from 3 government hospitals are invited. For patients who `re having mental imbalance, initially consultants will diagnose, what is the most

eligible way to start the treatment. For some, it`s initially with medication, for some it`s a therapeutic treatment and for some it could be a blend of both. In situations, where the therapeutic approaches are required, if the intended approach to be followed is based on CBT, that`s the place where this system can kick in.

After doing manual CBT analysis and if the same scenario is captured as in form of an internal-self talk, and handed over to this software to do the CBT analysis, this time with the refinements, outcomes are relatively good. Took evaluations from 10 consultant psychiatrists individually from the mental wards of different hospitals, and all gave satisfactory comments about the CBT segmentation.

After having a chat with the person, you tempt to get an idea about the temperament of the patient. Similarly requested to do a personnel reflection about same person, and later it was converted to English and entered to the system to do temperament analysis. Under this circumstance also, there is a significant match in the system generated factor composition as well as the expert judgments made.

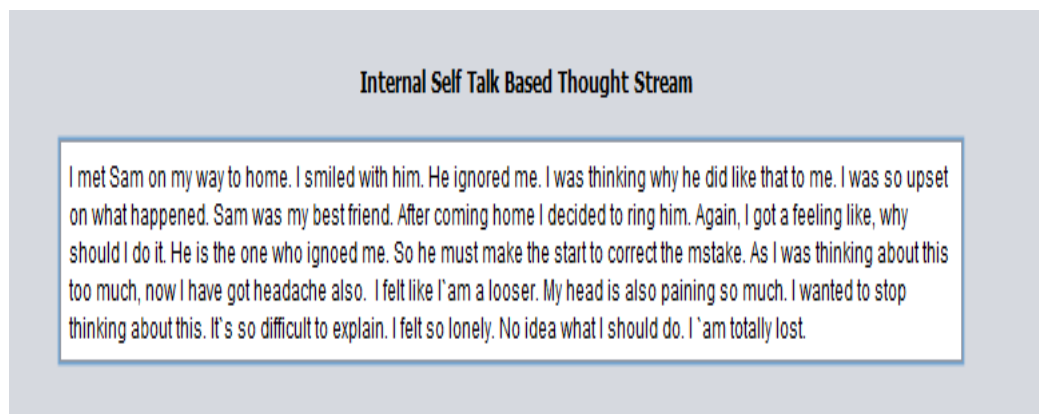Therefore with the amendments made to the system, significant improvement has taken place.

Internal Self Talk Based Thought Stream

I met Sam on my way to home. I smiled with him. He ignored me. I was thinking why he did like that to me. I was so upset on what happened. Sam was my best friend. After coming home I decided to ring him. Again, I got a feeling like, why should I do it. He is the one who ignoed me. So he must make the start to correct the mstake. As I was thinking about this too much, now I have got headache also. I felt like I`am a looser. My head is also paining so much. I wanted to stop thinking about this. It`s so difficult to explain. I felt so lonely. No idea what I should do. I `am totally lost.

Figure 9: Drools Rule Engine

Self-talk Segmentation Report	
Behaviors	Captured None
Emotions	I was so upset on what happened
	I felt so lonely
	I ` am totally lost
Thoughts	I was thinking why he did like that to me
	After coming home I decided to ring him
	Again , I got a feeling like , why should I do it
	I felt like I ` am a looser
	I wanted to stop thinking about this
	It ` s so difficult to explain
	No idea what I should do
ANTs	I felt like I ` am a looser
Physical Reactions	As I was thinking about this too much , now I have got headache also
	My head is also paining so much
Facts / Story	I met Sam on my way to home
	I smiled with him
	He ignored me
	Sam was my best friend
	He is the one who ignored me
	So he must make the start to correct the mistake

Figure 10: Itext report generated with the processed output of CBT

Personnel Factor Division - Overall Report	
Attribute	Effective Impact Percentage (%)
Agreebleness	0.0%
Conscientiousness	0.0%
Extraversion	0.0%
Neuroticism	63.6%
Openness	9.1%

Personnel Factor Division - Detail Value Composition Report		
Attribute	Status	Percentage (%)
Agreebleness	Negative	0.0%
	Positive	0.0%
Conscientiousness	Negative	0.0%
	Positive	0.0%
Extraversion	Negative	18.2%
	Positive	0.0%
Neuroticism	Negative	63.6%
	Positive	0.0%
Openness	Negative	9.1%
	Positive	9.1%

Figure 11: Itext based OCEAN report

Total executional flow of the system would be as follows
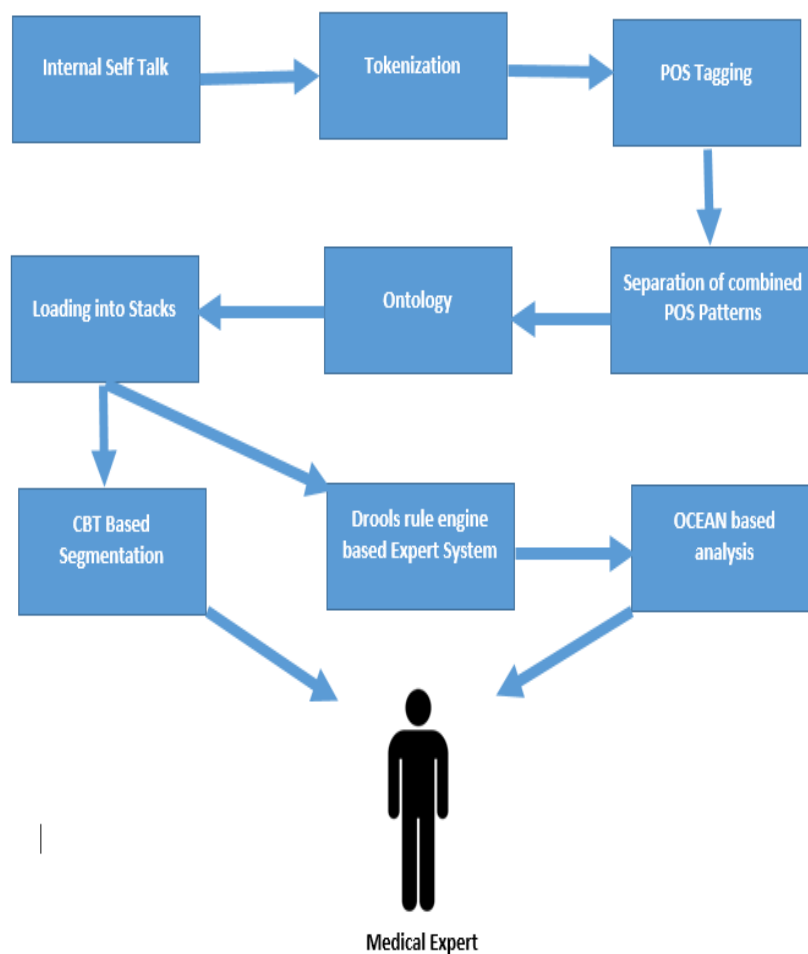
Figure 12: Total System Flow

CONCLUSION

The intension of this research is to introduce a mechanism, on how effectively an ICT based integration can be introduced to assist the psychologists and psychiatrists to facilitate their routine tasks.

Specially in a setting like Sri Lanka, as we have very few practitioners and it is assumed this integration will cut down their informational and emotional overload and will escalate the final quality of their services to patients and clients.

As in any system, there will also be plenty of limitations. This mechanism should not be never ever used to replace a medical consultant, hence the expertise of a human brain cannot be easily replicated. This system can only make their tasks easy via integrating all the dispersed information to a one place, and also will assist in following up of the regular patients. Also this system can be used to maintain legal evidences of the communications took place with the patient, in case where the patient is attempting to commit a crime or commit suicide. Not only that, it will support to react in advance in this sort of a situation, before things are going to be worst.

Different consultants have their very own practicing styles. Hence, there could be multiple applications of this system pertaining to the clinical practice of the consultant. Some might use this system from the very first day of the visit, but some might not initially introduce the system. They might have face to face discussions first and become get known to the patient and understand the patient from the instincts. Once the patient becomes more familiar, this system might be introduced.

For certain patients, this system might not be applicable at the initial stage. If the situation of the patient is critical, initially medication based treatments might be required. After some time, when the patient is recovered to a certain level, and when the consultant thinks, now it`s time to commence the therapeutic based treatments, system can kick in. Likewise it`s fair enough to say the application of this system is practitioner specific.

In capturing the personnel temperaments, it`s not fair enough to do it from one random internal-self –talk. So, small booklet containing some examples can be provided to the user. This will assist to identify how descriptive and richer the user should be and what are the areas the reflection should capture. If the reflection is made upon satisfying these criteria's, system will be able to do a more comprehensive OCEAN analysis, which will finally result in more accurate personnel temperament.

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