

# A SEMANTIC WEB MODEL FOR THE SITUATIONAL AWARENESS OF INDIGENOUS KNOWLEDGE IN HEALTH

Patience C. Bassey

Computer Science Department, University of Uyo  
Uyo, Akwa Ibom State, Nigeria.

and

Mfon M. Ntekop

Computer Science Department, University of Uyo  
Uyo, Akwa Ibom State, Nigeria.

## ABSTRACT

Most unsupervised indigenous knowledge (IK) are known to be very useful in combating critical health issues as well as being dangerous if the administration is abused. Despite the fact that these locally prepared herbal medicine are not encouraged to be used by the citizenry for known reasons, some people in our localities still use these products and testify to their usefulness. If there is awareness on the true sources of this indigenous knowledge with the dosage not exceeded, these products will be helpful in combating some critical health issues where orthodox medicine fails. It will also be helpful to the citizenry who may not be able to afford orthodox medicine as well as providing a means of livelihood for the traditional medical doctors (herbalists). This work is aimed at creating a computational model for situation awareness of indigenous knowledge in health that will help in information sharing using ontological modeling approach for semantic web. The resulting model will feature and share the successes as well as the challenges and the opportunities of indigenous knowledge in health as obtained by interviewing the traditional experts and the patients that have made use of these traditional products. This situation awareness of IK will help put IK to proper and safe use in handling critical health issues especially for the poor who can't afford expensive orthodox medicine.

**Keywords:** Ontological model, traditional medicine, critical health issues, knowledge sharing, decision making model.

## 1. INTRODUCTION

There is hardly any community, no matter how developed they are where people will not sometimes refer to traditional tools for use in handling one health issue or the other. This knowledge has so been transferred verbally from one traditionalist to the other without proper information on the dosage to be administered. Sometimes due to the anxiety of getting the effect faster, most of these traditional products are either consumed in large quantities such that they become harmful instead of the known

positive effect it produces. One is excited about taking these indigenous products as the rate of the people that get solutions to some of the critical health issues is on the increase. Some of these critical health issues are known to have no cure or can only be managed on taking orthodox medicines. The target users of the product often fall into wrong hands of quacks, who claim to be traditional medicine men but sometimes combining some rituals or giving out fake mixtures with the aim of making money. The problem remains, how can the intended users of the products distinguish the right source from the quacks?

This informs us on the need to bring the use of this indigenous knowledge in health to the awareness of everyone who may need them. The advent of semantic web today is a necessary tool for knowledge sharing amongst people. Our focus on knowledge sharing is fully aware of the way and manner that these traditional medical doctors do not want to expose their knowledge. So our model is not sharing the products, treatments and the dosage rather it models the recommended sources (name of traditional medical doctor, address, etc.) of the products as well as the critical health issues that these products are known to handle.

Endsley and Smolensky [1] defines situational awareness as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and a projection of their status in the near future". Several Situation Awareness (SA) technologies exist: such as sensor web, semantic web, knowledge management applications databases, automated data, etc.

To create a computational model that will help in sharing meaningful information – concerning the challenges and opportunities - of indigenous knowledge in health, there is need for an ontological model that fits into the semantic web technology. This ontological model will be advantageous in several ways. Apart from serving as source of right information for the intended users of the products, it will also serve as an avenue for advertisement to the traditional medical doctors. Policy makers should ensure that illegal practices are stopped as they work closely with researchers to ensure that only tested and

proven sources are included in the knowledge base system. Also, awareness campaign should be embarked upon to cause the general public and intended users to know the right places to visit. By so doing, the situation awareness of IK will help balance the differences between the English medical doctors and the traditional medical doctors thereby putting the IK to proper and safe use for the citizenry.

**2. THEORIES OF SITUATIONAL AWARENESS**

The three most widely accepted theories of situational awareness include: Three-Level model, The Cognitive Subsystems model and The Perceptual model. Below is a discussion on these models.

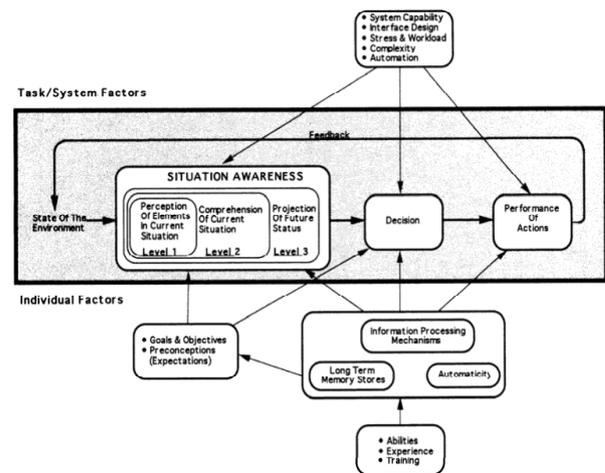
**Three-level model**

Developed by Endsley, the three-level model of situational awareness was initially to serve the aviation industry in areas of aircraft piloting and air traffic control. In this model, it is pertinent that industry workers keep up-to-date with an environment that is characterized with high volatility. However, this model could be extended to time critical domains such as nuclear, power, medicine etc. [2] Endsley’s model [3] is arranged into three hierarchical levels of situational assessment, which includes:

Level 1 SA (Perception): In Endsley’s model, Level 1 is the lowest level in the hierarchy and it’s concerned with the pilot’s perception and collection of information around him including behaviour of the aircraft, co-pilot, weather, air traffic controllers, etc. At this level, there is no interpretation of data but a confirmation of status of the variables around him

Level 2 SA (Comprehension): Comprehension is next in hierarchy after perception. There will therefore be a transition from level 1 SA to level 2 SA only when data gathered in level 1 SA are synthesised in an order that enables the pilot have an understanding of the relevance of his tasks. Without comprehension, the pilot will be ignorant of how elements in level 1 SA combine to influence his mission [4]

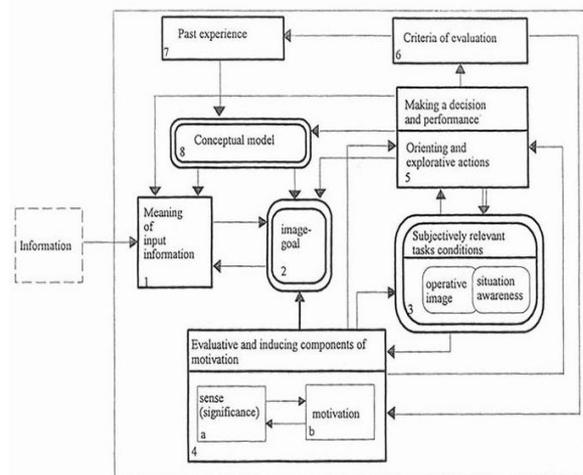
Level 3 SA (Prediction): This level is the highest level of SA and is concerned with prediction of the future of elements in the environment. The accuracy of such a prediction is largely dependent upon the successes of level 1 and level 2 situational awareness. Anticipation of the projected future situation provides the pilot with time to resolve conflicts and plan a course of action to meet their goals. Figure 1 below shows an illustration of Endsley’s model, which presents situational awareness as an entity that exists within a cognitive model of human activity in a dynamic system. In this model, Endsley shows the relationship that exists between situational awareness and relative factors such as task and individual.



**Figure 1: The three-level model of situational awareness [1]**

**Interactive sub-systems**

The interactive sub-systems model was developed by Bedney & Meister [5]. Their model reveals that the extent of interaction between processes is solely dependent on the goals of the individual and the nature of the task. This is unlike Endsley’s three-level model that possesses cognitive processes such as perception, memory and thinking, which are intrinsic to the model [6]. Such a model with the interactive sub-system is seen in the Bredny & Meister’s model [5]. Bedny & Meister’s [5] model consists of eight functional blocks that are connected through feed forwards and backwards loops as presented in figure 2.



**Figure 2: Interactive sub-systems approach [5]**

As figure 2 shows, each function block has a specific task in the development of situational awareness and structure of activity. The content of each block will depend upon the nature of the dynamic situation [7].

**The perceptual cycle**

The perceptual cycle is a product of Neisser’s work [8]. In his work, Neisser asserts that situational awareness does not exist in an individual or in the world, but that it exists within the confines of an individual’s interaction with the environment. He argues that quest for information in a known context makes an individual anticipate certain

information, thereby creating a bias to one's openness to unanticipated information sources. The perceptual cycle upholds the proposition that there is a close relationship between the human thought and its interaction with the environment [9]. This can be seen in figure 3 below, which is constituted by an inner circle that illustrates the perceptual cycle and an outer exploratory circle.

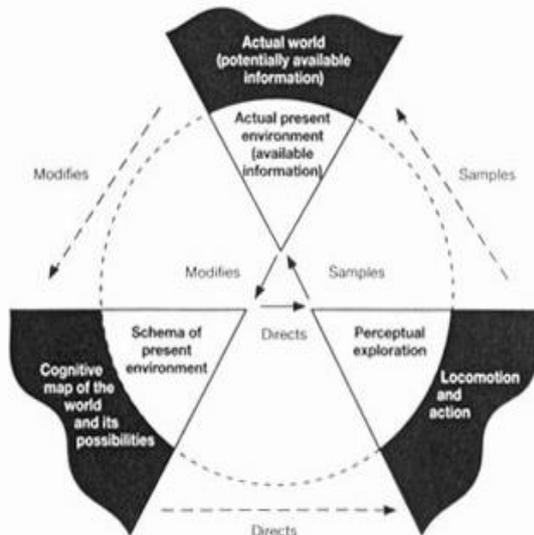


Figure 3: Expanded view of the perceptual cycle [8]

### 3. APPLICATIONS OF SITUATIONAL AWARENESS

Situational Awareness has been applied in diverse sectors of the economy but most especially in time critical areas such as aviation (transport), medicine (health), nuclear and power (energy). In health, situational awareness is implemented as a system and as a program. Toner [10] provides a list of standalone situational awareness systems that are in use, and their functions as shown in table 1.

Table 1: Standalone Situational Awareness Systems in health [10]

	TYPE	NAME	USE
1.	Disease Detection and Surveillance	a. BioWatch	USG system to detect certain bioterrorism agents in the air
		b. BioSense	the USG system to gather syndromic surveillance data from hospitals)
		c. RODS	Used in gathering syndromic surveillance data from hospitals
		d. ESSENCE	
		e. AEGIS	
		f. ILInet	CDC's influenza surveillance systems
		g. Global Influenza Surveillance Network (GISN)	Influenza surveillance system
2.	News and Web Trawling	a. ProMED	Distributes disease reports submitted from around the world
		b. Global Public Health Intelligence Network (GPHIN)	mines global news for disease reports
		c. Google Flu Trends system	Online site for flu reporting
3.	Alerting	a. Health Alert Network	sends messages from the CDC and state health departments to clinicians
4.	Bed Tracking	a. Infosys' Bed Management System	for reporting bed data to Management and government
		b. Bed-Trac Bed Management System	Manages Bed availability using RFID
5.	Patient Tracking	a. PatientTrack	Patient flow management
		b. Ekahau	Incident Command Systems
		c. Elpas	Wandering patient tracking
		d. Aware point	Electronic Health Records

### 3.1 Cases of Indigenous Knowledge on Critical Health Issues

The application of the situation awareness model is not limited as its efficacy can be extended to the promotion of indigenous knowledge in our locality. This is feasible in the cases of indigenous knowledge adapted from researches conducted in the Department of Plant Science and Biotechnology, University of Port Harcourt shown in table 2.

**Table 2: Laboratory proven indigenous knowledge as remedy for critical health issues (Source: department of plant science and Biotechnology, University of Port Harcourt, Nigeria)**

S/N	AILMENT	REMEDY	USAGE
1	Diabetes	Mixture of extracts from alligator pepper seeds mixed, bitter kola and bitter leaf + water	2 weeks
2	Beri-beri	Chew whole alligator pepper + 2 gingers	2 days
3	Female Infertility	Soup made from grounded whole pepper, ripe pawpaw seeds and grounded dried locus beans	1 weeks
4	Fresh wounds	Wounds could be treated by applying goat weed sap	3 times
5	Ring worm	Cashew tincture	2 drops 4-5 times daily
6	High BP	Bark and leaves of cashew tree can be used as diuretic	2 times daily for 1 week
7	Catarrh and Stomachache	Local application of lime juice extract + honey	As need be
8	Irregular menstrual cycle	Juice extract from fluted pumpkin leaves and rubber tree leaves	Daily
9	Typhoid	Lemon grass leave, 25 limes, 2 grapes, 2 unripe pawpaw, 2 unripe pineapple and garlic boiled in 2 liters of water for 30mins	Twice daily for 3days
10	Fibroids	Nuts from unripe palm fruits prevents fibroid	Chew 25 -30 nuts daily for 12 weeks
11	Poison	Palm oil used as antidote	
12	Convulsion/Skin ailments	Oil from palm kernel	
13	Throat	Chew bitter kola	

	infections	nuts	
14	Malaria	Boil mango leaves in water and drink the solution	Twice daily for 3 days
		Boil broom weed in water and drink the solution	
15	Low blood count	Juice extract of guava leaves mixed with fresh water	1 glass 2 times daily for 1 week
16	Diarrhea	Extract from Utazi leaves mixed with water	1 glass thrice daily
17	Post-Childbirth womb cleansing		
18	Native Pear	Eaten as remedy for internal heat	As need be
19	Measles Small Pox Chicken Pox	Mixture of bitter leaf extract and palm wine	Drink 1 glass daily and rub solution on body

From table 2, it can be observed that some of these treatments lack the usage directives and more so, there is inadequate information to motivate other people that have similar ailments and may require those treatments. More so, if we need to encourage our traditional medicine, we can provide some other information as represented in the ontological diagram without necessarily revealing the knowledge for treatment. This will bring encouragement to them rather than selling out their knowledge cheaply, which is the major cause of their divergence. In other to promote indigenous knowledge from where these researches emanated from, there is need to encourage and support the patency of these indigenous knowledge. Of course, this cannot be given without proper assessment around the harm it may cause if not administered properly. To help in the integration, re-use and dissemination of this knowledge, an ontological model of all necessary knowledge need to be constructed with the interest of all taken into consideration.

#### 4. ONTOLOGICAL MODELING FOR THE WEB

As an explicit specification of a conceptualization, that is, an abstract, simplified view of the world that we wish to represent for some purpose [11], the ontological model shown in figure 4 can be built for the web to contain these domain concepts.

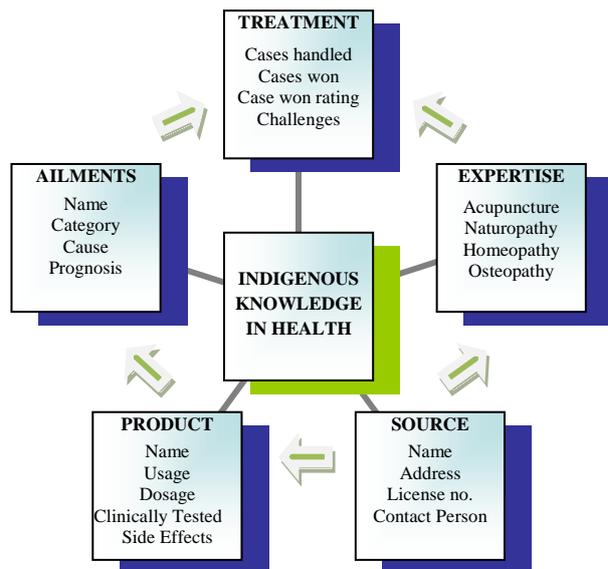


Figure 4: An Ontological Model of IK in Health

The diagram above shows the ontology of the proposed knowledge-based system of indigenous knowledge in health. This system has five main entities and each entity has its attributes. The arrows between entities show the relationships that exist between entities. Typically, a record in the system above holds a contact detail of the SOURCE of the knowledge; the PRODUCT/knowledge offered by this source and its administration; a description of possible AILMENTS that such a product is capable of remedying; number of TREATMENT cases handled with recorded successes for the individual/company, and the treatment approach (EXPERTISE) employed by the individual/company.

Implementing this ontology using ontological tools like protégé will make it simple to subsequently edit or add new knowledge to the knowledge based system for use and re-use.

Since most of the SA systems in health work as standalone, we look beyond this limitation in our framework by proposing a situational awareness tool that is made available on the semantic web for widespread of information and re-use [12]. The reliability of the information on the web is dependent on the availability of a strong information management interface built into the framework as shown in the architectural framework below:

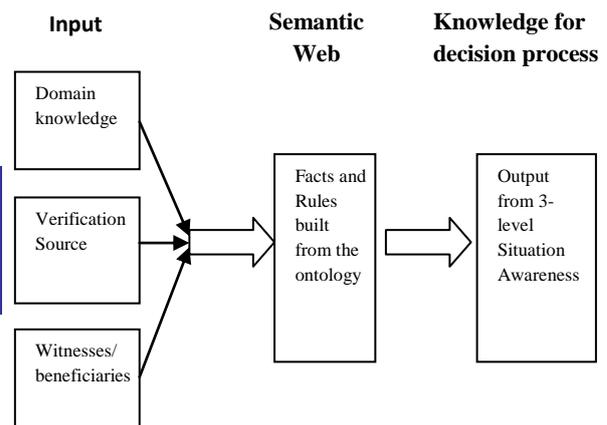


Figure 5: The architectural framework on the semantic WEB

The architectural framework diagram on the semantic Web gathers as input, the domain knowledge, probably supplied by the traditional medicine man, input from the research and health agency that carried out the verification process, and confessions from witnesses that benefited from these products. These are sent to the semantic web as facts with built-in rules that aids in any meaning process from the fact. The output from the semantic web which might have passed through the three level situation awareness model (perception, comprehension and prediction) is the required knowledge for any decision process.

### 5. CONCLUSION

The quest to promote indigenous knowledge and/or traditional medicine using the three level situation awareness has resulted in the design of an ontological model that aims at information sharing through the semantic web. The challenges and the opportunities of indigenous knowledge in health as obtained by interviewing the traditional experts and the patients that have made use of these traditional products will also be shared. This will help to put indigenous knowledge to proper and safe use in handling critical health issues especially for the poor who cannot afford expensive orthodox medicine. Such knowledge are required for decision processes involving some of the critical health issues.

### 6. REFERENCES

- [1] Endsley, M. R. and Smolensky, M. W. (1988) Situational Awareness in air Traffic Control: The Picture. *Human Factors in Air Traffic Control...*
- [2] Adams, M. J., Tenney, Y. J., & Pew, R. W. (1995) Situation awareness and the cognitive management of complex systems. *Human Factors*, 37(1) 85-104.
- [3] Endsley, M. R. and Garland D. J. (2000) *Situation Awareness Analysis and Measurement*. Mahwah, NJ: Lawrence Erlbaum Associates

- [4] Endsley, M. R. (1995) Measurement of situation awareness in dynamic systems. *Human Factors*, 37(1), 65-84
- [5] Bedny, G. and Meister, D. (1999) Theory of Activity and Situation Awareness. *Int. J. Cognitive Ergonomics* 3 (1) 63-72.
- [6] Stanton, N. A.; Chambers, P. R. G. & Piggott, J., (2001) Situational Awareness and Safety. *Safety Science*, 39, 189-204.
- [7] Wickens, C. D. (1992). *Engineering Psychology and Human Performance* (2<sup>nd</sup> ed.). New York: Harper Collins.
- [8] Neisser, U. (1976). *Cognition and Reality*. Freeman.
- [9] Smith, K., & Hancock, P. A. (1995) Situation awareness is adaptive, externally directed consciousness. *Human Factors*, 37(1), 137-148
- [10] Toner, E. S. (2009). Creating situational awareness: A systems approach. In *Workshop on Medical Surge Capacity, Institute of Medicine Forum on Medical and Public Health Preparedness for Catastrophic Events*.
- [11] Gruber, T. R. (1993). A translation approach to portable ontology specifications. In: *Knowledge Acquisition*. 2(5). 199-220. <http://tomgruber.org/writing/ontolingua-kaj-1993.pdf>
- [12] Simperl, Elena (2009): Reusing ontologies on the Semantic Web: A feasibility study. *Data & Knowledge Engineering* No 68 pp 905–925