Transition from Observation To Knowledge To Intelligence (TOKI)

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Framework for developing a Health Decision Support System

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Abstract. Decision Support Systems (DSS) represent a concept of the role of computers within the decision-making process. In this work we propose a framework that will assist decision makers. The conceptual model of the system showing various modules and entities that constitute the proposed system is presented. In this paper, we are concerned with rational decision-making process. This choice is based on the fact that rational decision-making process depends heavily on the use of information. The approach for this proposed framework is to extend the current framework of information system. The architecture is composed of components with four implementation phases: decision problem specification, data collection, matching decisional problem with information need, analysis and interpretation.

Keywords: framework, decision support system, decision problem, health system

1. Introduction

Decision Support Systems (DSS) represent a concept of the role of computers within the decision-making process. We have noticed that in recent years, there is regain of the concept of decision support system in the keywords or titles in scientific papers. However, this phenomenon is not new. (Keen, P. (1980)) stated that "Last year's article on "Interactive marketing model" is cut and pasted and re-submitted with "Decision Support System sno-paked" instead.

In (David A. 2016) we noted that "All living entities (from individuals to socio-economic organizations) make decisions, employing one or more decision making processes. In this paper, we are concerned with rational decision-making process. This choice is based on the fact that rational decision-making process depends heavily on the use of information".

DSS is a concept with the following properties, (Sprague, 1980):

1) DSS tends to be aimed at the less well structured, underspecified problem that upper level managers typically face;
2) DSS attempts to combine the use of models or analytic techniques with traditional data access and retrieval functions;
3) DSS specifically focuses on features which make them easy to use by non-computer-proficient people in an interactive mode; and
4) DSS emphasizes flexibility and adaptability to accommodate changes in the environment and the decision-making approach of the user.

The main objective of this paper is to highlight how an information system can incorporate functional characteristics in **support** of medical health decision. We focus on the term support since the system will be limited to this role. We will expatiate on the concept of support, the involvement of the medical practitioners in designing the information system to achieve this goal. The main scientific issues are: (1) what are the data features to use and for what medical problem; (2) what are the

functional characteristics in support of medical decision and how they can be implemented.

2. Proposal of a framework for a medical health decision support system

The concepts that wee present result from a long period of research work by Prof Amos David, already published in (David, A. (1990), Bueno, D. et al (2002), David, A. (2016), and David, A., & Ndjock, N. (2018)). There has also been exchanges on the topic with Dr. Ajibade Adesiyun (Adesiyun, Ajibade, & Amira, C.O. (2019))

As presented in David, A., & Ndjock, N. (2018), the approach for this proposed framework is to extend the current framework of information system. The architecture of the proposed extended information system is presented in Figure 1.

A-B-C: The information to be managed by the system is determined by the set of decisional problems as specified by the decision maker. The decision make in the health HDSS is the medical doctor. As in rational decision making and in competitive intelligence process, this is the most important part of the system. This will determine the relevance of the information to be collected.

C-D: After collection, the information, very often, need processing to allow for integration in the database (data warehouse) and prepare the information for the visualization of the results of the system. Because of the huge volume of data that may be necessary, the techniques of Big Data come in.

A-E-D: These components correspond to how the end-user will extract a subset of information from the system. This corresponds to the matching operation in information retrieval systems. We were inspired by the cognitive phases in human learning: observation, elementary abstraction, symbolization and annotation. This translates to the model **EQuA^{2}te** in information retrieval system (Explore,

Query, Analyze, Annotate). The exploration function consists in allowing the end-user to explore the who database. He doesn't necessarily have real knowledge his information need. The query function allows the end-user to submit query expressions to the system. For this, it is expected of him to have a clearer knowledge of his information need. In fact, information retrieval through query makes use of the concept of "content-based retrieval". The user obtains information based on his prior knowledge of the content of the database. The analysis function represents the use of cross-analysis functions to obtain what the end-user needs. And finally, the annotation function allows the user to attach annotations to his findings. We have implemented these approaches in some systems that we developed.

I: In terms of knowledge discovery and creation of intelligence, this component is the most important. We proposed various forms of retrospective analyses as well as various forms of visualization of the results (charts, charts, maps) with the possibility of dynamically varying the indicators and the mode of visual presentation. We were inspired by the concept of observatory.

G: This corresponds to the interpretation and decision phase in the decision process steps. We believe that this phase should be carried out by the decision maker (in this case the medical doctor) just like he determines and specifies the decision problem.

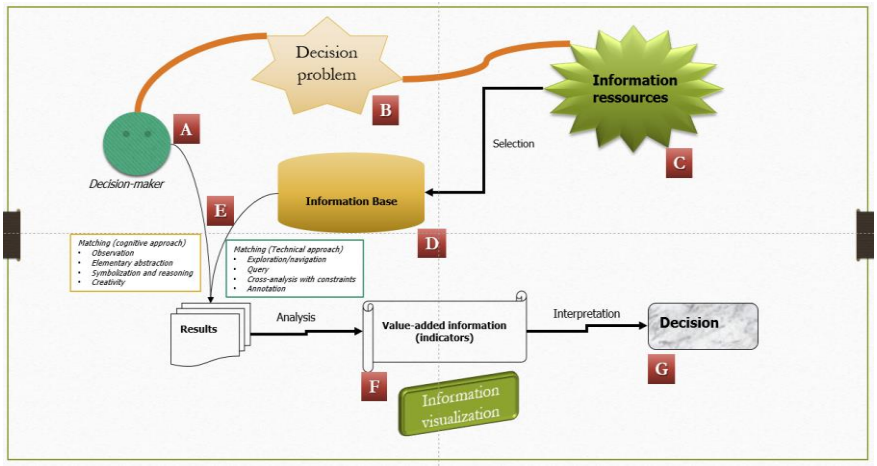

Figure 1: Architecture of an extended information system

The data collection component (C-D) deals with the types of data necessary for arriving at efficient decision. This is a primary component because the global success of the system depends on how well it performs. It connects the system to the decisional environment – mainly through the data collected and the methods employed for collecting them. The scientific issues related to this component include identification and specification of a decisional problem, feature engineering, the properties of technologies for data collection such as Internet of Things (sensors, transmitters, storage, etc.).

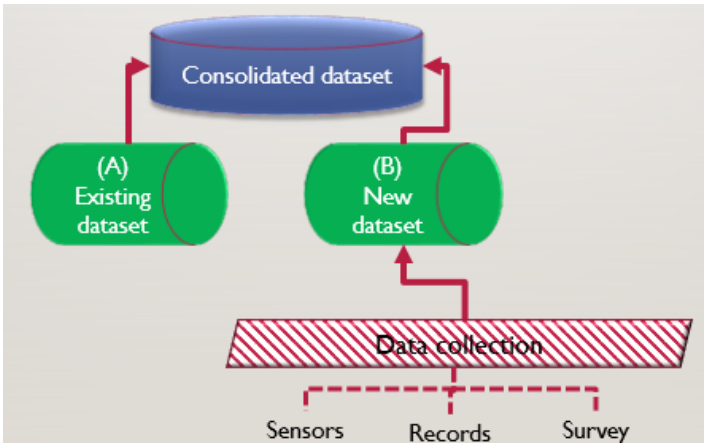

Figure 2: Data selection

In the medical application domain, the dataset to use could either be constituted by existing dataset or by new dataset to be collected. The main difference between the two types of dataset is that in the first case, little or nothing can be done to modify what has already been collected. In the second case, the data to be collected can be influenced by the specification of the medical doctor before carrying out the data collection.

3. Decision Support

As regards the "support" functionality of the framework, we have identified five types of support that can be provided to the medical doctor: suggestion, recommendation, prescription and verification.

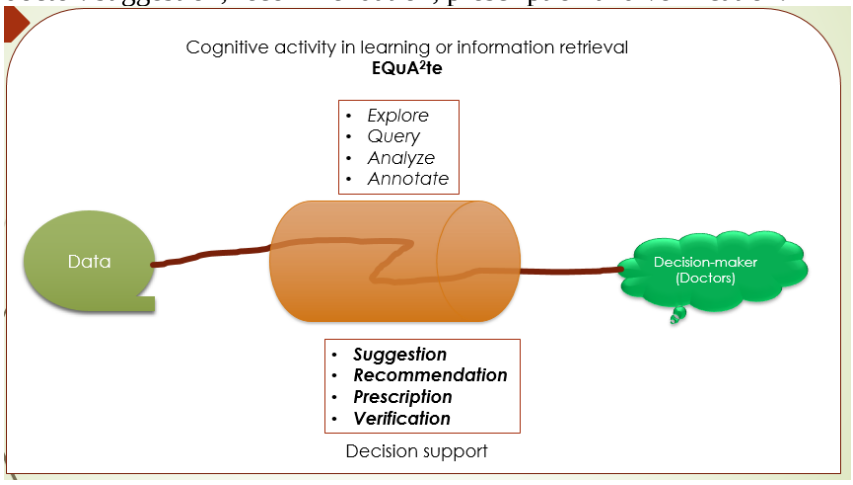

Figure 3: From data to decision/intelligence

With the use of some mathematical and statistical models, mainly in the domain of data analytics and machine learning, the system should be able to make suggestions, recommend some solutions, prescribe some steps and permits verification of data or hypothesis and the case at hand. The detailed specification of these functionalities should be established in collaboration some medical doctors.

4. Conclusion

There is an ongoing project initiative in collaboration Dr. E.A. Adesiyun and some of his leagues from Lagos University Teaching Hospital. The specific aims of the HDSS study are to provide insight

into challenges associated with morbidity and mortality among Chronic Kidney Disease patients. Some or our doctorate students are working on the determination of features from identified decisional problems; the use of data analytics for data exploration; the implementation using big data ecosystem for a global health decision support system.

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