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Research Paper

Development of a Simple Expert System on a CBC Test using VB.Net

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ABSTRACT: *In this paper, it was purposed to design and develop a simple laboratory test result diagnosis on CBC using VB.Net employing the components and interface of Expert system. The system created in VB.Net was presented using laboratory test for diagnosis. Primary source of data were domain expert like Medical Technologist and Doctor done through interview method to develop the knowledge base rule to implement, other sources were also considered. VB.Net 10 programming language was used to create the inference engine, working storage and user interface, for database, SQL server 2008 was utilized. The system was able to provide a simple diagnosis based on the inputted laboratory result of the user/patient, despite not utilizing uncertainty process. Despite being able to diagnose, providing probability for uncertainty must be applied to further provide a more accurate diagnosis.*

KEYWORDS: *Expert System, Computer Programming, VB.Net, Laboratory Test*

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I. INTRODUCTION

Artificial Intelligence is referred to as the simulation of human intelligence by a system or a machine with the goal of developing a machine that may be able to think like humans and mimic their behaviors, including perceiving, reasoning, learning, planning, predicting, and so on [1]. Expert system is one of the scopes of artificial intelligence (artificial intelligent) an area that mimics the behavior of or a group of experts in solving problems or giving diagnosis [2]. Expert system have numerous major system components and interface with individuals who interact with the system in different roles [3]. First the Knowledge Base, which is not just a database, it contain logical statements or rules along with facts/data [3]. Most expert systems are designed with modules that help the Knowledge Engineer develop the Knowledge Base by providing user interfaces to facilitate the required tasks [4]. To develop a knowledge base, data from Domain expert, where their input is usually needed for data tasks that require experiential knowledge and judgment, including medical diagnosis and forensic analysis [5]. Having specialized training, domain experts' time is usually expensive and limited [6, 7], they are highly trained individuals, allowing systems to accelerate input using domain-specific assumptions and ontologies [8, 9]. Domain experts must go through a data/knowledge engineer often to execute the relevant query [10, 11], or even to extract information from unstructured notes [12]. Queries identified by user or user input are inferred by the expert system keeping in view the knowledge base built in it, the insight information then extracted the knowledge base through the inference engine [13]. To acquire data specific to the problem being solve a working storage was built within the inference engine [3]. Usability is a design principle with the goal of enhancing efficiency and ease of use despite the underlying logical design of a stored program [14, 15], so emphasis on user interface for the system must be viable [15]. For the purpose of this study, Complete blood count (CBC) will be used, it is one of the most common blood tests requested by clinicians and evaluates the total numbers and characteristics of cell components in the blood [16]. For the development of the system, VB.Net will be utilized, derived from Visual Basic which was then derived from BASIC, the programming language enables the rapid application development (RAD) of graphical user interface (GUI) applications, and access to databases using Data Access Objects (DAO) [17]. Visual Basic uses a visual approach to design user interfaces with forms, while coding uses basic languages that tend to be easily understood [18-20]. The purpose of the study is to design and to develop a simple laboratory test result diagnosis on CBC using VB.Net employing the components and interface of Expert system.

II. METHODS

2.1 Data Gathering

The system will be created using a standard procedure following a laboratory test, in this case Complete blood Count or Hematology. To gather data for knowledge base, a domain expert will be interviewed to deduce the correct flow of decision tree. Medical Technologist and Doctor were questioned to structure the knowledge base and will be considered as primary source of data. Secondary sources will include other materials such as books and anecdotal with similar topic on CBC.

2.2 Project Design

The proposed system is an expert system, the project should have at least 3 components to be considered one, designing the knowledge base were most data comes from the domain expert, and the encoding expertise of a knowledge engineer, creating an inference engine together with a working storage or knowledge acquisition facility to link the 2 components through the help of a system engineer and designing the user interface for user preference.

2.3 Programming Technique

The proponent will use the 4th generation technique (4GT) in the development of the Expert System based on NPL or Non- Procedural Language techniques. The 4GT employ various tools for the automatic generation of source codes depending on the specifications [21-22]. It uses the non-procedural language for report generation, database query, data manipulation, user interface, code generation, spread sheet capabilities and more.

2.4 Programming Language and Database

VB.Net 2010 will be the programming language to be used, not particularly used for expert system, but its ease of use and rapid development will be utilized to design simple expert system. For the knowledge base, SQL Server 2008 via DAO will be used.

III. PROPOSED SYSTEM

3.1 Knowledge Base

Table 1: Example Decision Rule provided by Domain Expert (Hemoglobin count)

Age	Gender	Range	Symptoms	Recommendation
>=15	Male	Low	fatigue, weakness, and other signs of anemia	Eating food rich in iron, more supplements
>=15	Male	13-17 g/dl	Normal	Stay on a healthy path
>=15	Male	High	blood clots, heart attack, stroke	Avoid smoking, use of doctor prescribe supplements or medication
>=15	Female	Low	fatigue, weakness, and other signs of anemia	Eating food rich in iron, more supplements
>=15	Female	11.5-15.5 g/dl	Normal	Stay on a healthy path
>=15	Female	High	blood clots, heart attack, stroke	Avoid smoking, other supplements

Table 1 shows an example decision rule to be implemented in the knowledge base as provided by the domain expert. Shown in the table is only for the hemoglobin count as the other data follows the same routine. Recommendation for the patient or user will be based on the input of age gender and hemoglobin count for this sample. Also at the moment what was presented here is the adult age or near adult range of 15 and above, were male and female has a different normal range. If range is below the normal value of 13 to 17 g/dl it will show the symptoms like “fatigue, weakness and other signs of anemia”, with a recommendation to “Eating food rich in iron, or using more supplements”. Likewise range above the normal value will show a symptoms of “blood clots, heart attack, stroke”, and a recommendation of “Avoid smoking, other supplements”. Otherwise normal range would recommend to “Stay on a healthy path”. Probability in uncertainty was not provided at present, and is part of the limitation. Other units like Hematocrit, Platelet count, WBC, RBC and the rest have similar procedure. All information on knowledge base was provided by either a doctor or medical technologist and compiled to create the database.

3.2 Database for Inference Engine and Working Storage

After constructing the knowledge base, the said rules were prepared for inference engine and working storage. The proponent acted as both the knowledge and system engineer. The database used was SQL server 2008 exported to Microsoft VB.net 2010. Database will be extracted and presented in DAO.

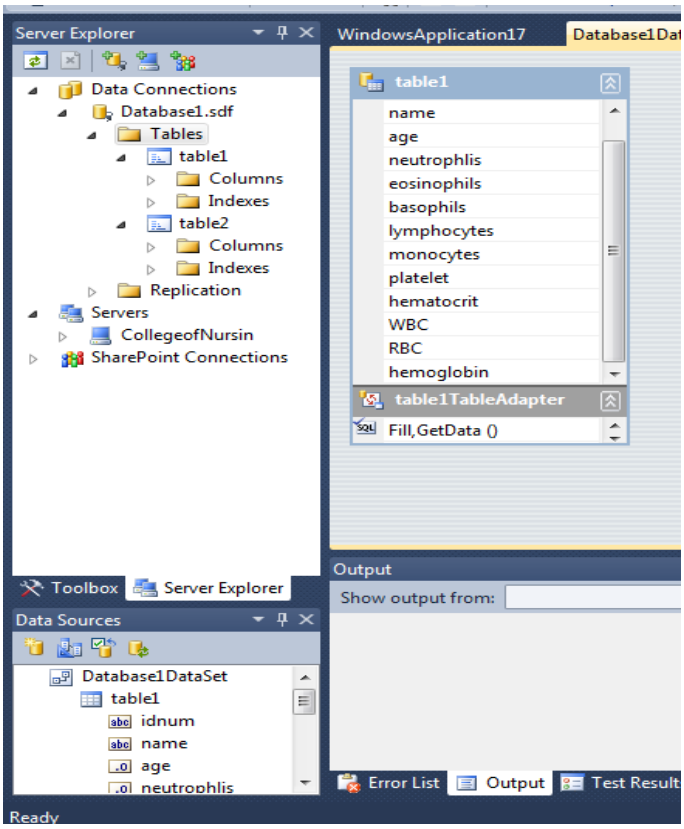

Figure 1: Database Design Imported from SQL server 2008

Figure is the screen layout of the database and table view of the system. User input will inlcude user id, name, age, and units of hematology including neutrophilis, eosinophils, basophils, lympocites, monocytes, platelet count, hematocrit, WBC, RBC and Hemoglobin counts. All units are subject to differents rules and action based on decision rules.

3.3 User Interface

To provide ease of use for the user of the system, user interface was created through Microsoft VB.net 2010 for its non-procedural method and rapid application development.

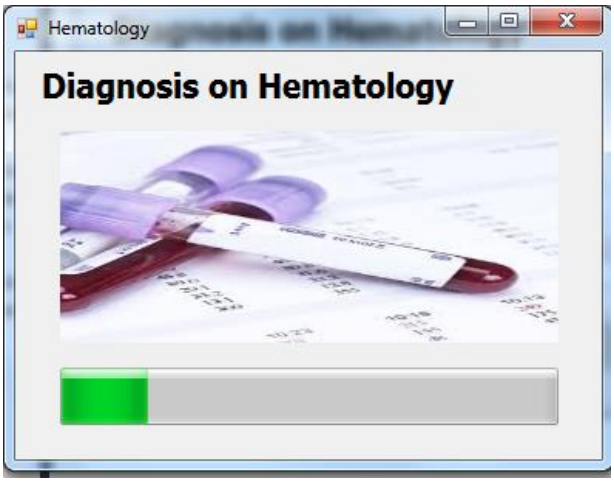

Figure 2: Splash Screen

As shown on figure 2, the splash screen with an actual picture of container for blood sample was used. This is to attract users on the simple design of the system.

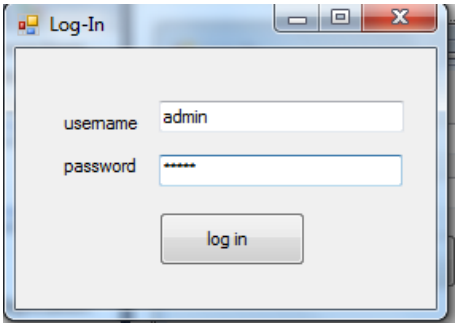

Figure 3: Access Page

To provide security in the usage, the system has an access page, as seen in figure 3, although with a default password that is changeable or updatable and was subjected to another table on the same database. Like any other system, access page is usable only for 3 attempts, after which the system will auto shut down and can be used once reopened.

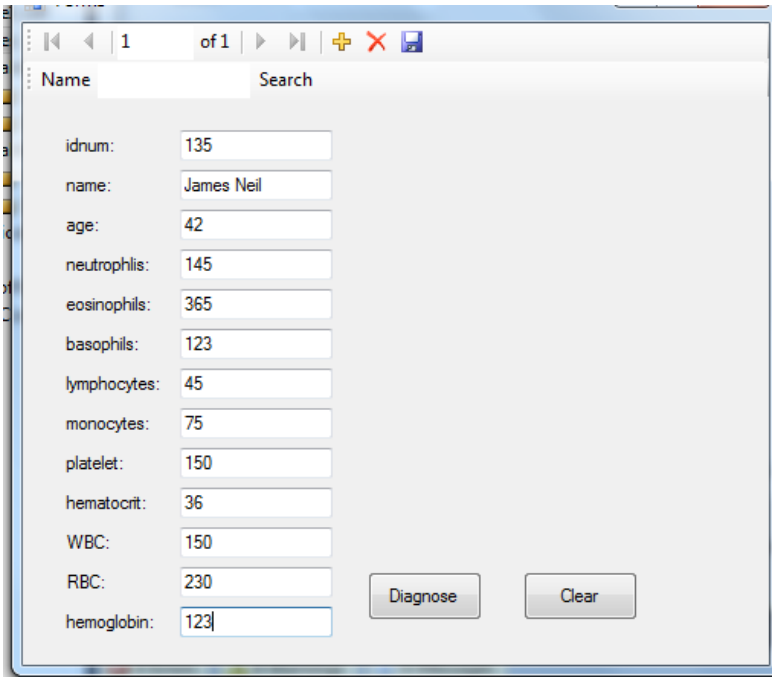

Figure 4: User Input

User will input user profile and units of blood counts on the text box provided which were link to the database. Together with the rules from the inference engine and working storage, it will be able to provide patient recommendation once the text box was filled and 'Diagnose' command button was click. User's also has an option to add, edit, delete and save the input. Data retrieval is also included in the system. Another button named 'Clear' to reset the data filled by the user.

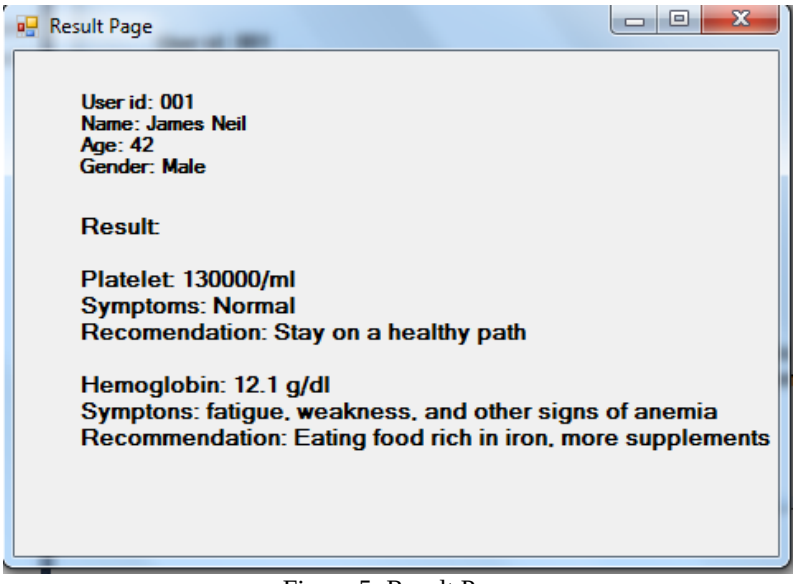

Figure 5: Result Page

After user input and clicking the button, Result page will appear, it will show the user input profile of user id, name, age and gender, follwoed by results depending on the test made. As shown on figure 5 a sample count on normal units of platelet recommending to "Stay on a healthy path" and hemoglobin count result showing sysmptoms of "fatigue, weakness and other sign of anemia and recommendation of "Eating food rich in iron and more supplement". The results page and data input is retievable from the database. The working storage and inference engine provided the decision rules shown on the result base on the knowledge base.

IV. CONCLUSION

The research presented shows a designed and working prototype of a simple laboratory test result diagnosis on CBC created in VB.Net which follows the components and interface of developing an expert system. The knowledge base was successfully extracted from group of experts in the field of medicine and medical technology, known as domain expert. The knowledge engineer then created a rule base in a table to permit ease of transfer to database, linking it properly for dealing with inference engine and working storage. Created in SQL server 2008 and extracted in VB forms using DAO, the user input and rules was stored in the database, in addition to the user log-in data. User interface was created with VB.Net 2010 as a front-end to the knowledge base and inference engine. The created system was able to display simple diagnosis based on user input after query extracted result from the database and displayed in result page. The three major components of Expert system; knowledge base, inference engine and user interface and how it interacts with domain expert, knowledge and system engineer, and user was explored in this study.

V. RECOMMENDATION

Despite a working prototype, some aspects in the planning and development stages might be considered. One is to choose domain expert from the exact same field as your expert system, to provide a more accurate diagnosis and also add a probability for uncertainty. Although rule based diagnosis was used, overlapping test results were not considered as deeper test would be needed for this kind of results. For the use of programming language it is preferred to use a language designed for expert system like PROLOG or LISP, although working, VB.Net was chosen for its availability and ease of use together with rapid application as compared to other programming languages. Further and longer study was needed to perfect the system.

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