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Using Forward Chaining Method For Diagnose Diabetes Disease

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Abstract

Diabetes Mellitus (DM) is a disease that affects many people who are overweight or could be a descendant of this disease.There are several classifications of diabetes, namely: Type1, type2 other specific and gestational diabetes.Society needs a technology to diagnose early diabetes from symptoms. In this expert system uses forward chaining method that is built using the PHP programming language and MySQL database. Knowledge Representation is useful in representing phenomena into a mathematical rule that will be stored in a database. The database consists of several tables, including symptoms, symptoms disease, disease, and questions. Knowledge Base materials sourced from internet and medical books on diabetes. The purpose of this system is that people can diagnose the diabetes disease.

Keywords: Forward chaining Method, Expert System, Knowledge Base, PHP, Diabetes disease.

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استخدم طريقة السلسلة الامامية لتشخيص مرض السكرى

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الملخص

مرض السكري هو مرض يصيب العديد من الأشخاص الذين يعانون من زيادةفي الوزن أو يمكن أن يكونوا منحدرين من هذا المرض وهناك عدة تصنيفات لمرض السكري وهي النوع 1 والنوع 2 والسكري الحملي. يحتاج المجتمع إلى تقنية لتشخيص المبكر لمرض السكري عن طريق الأعراض وفي هذا النظام الخبير يستخدم أسلوب التسلسل الأمامي الذي تم إنشاؤه باستخدام لغة برمجة PHP وقاعدة بيانات MySQL. تمثيل المعرفة مفيد في تمثيل الظواهر بواسطة قواعد رياضية يتم تخزينها في قاعدة بيانات. تتكون قاعدة البيانات من عدة جداول بما في ذلك أعراض المرض والمرض والأسئلة. يتم الحصول على مواد قواعد المعرفة من الإنترنت والكتب الطبية عن مرض السكري. الغرض من هذا النظام هو أن يتمكن الاشخاص من تشخيص مرض السكري.

الكلمات المفتاحية: طريقة التسلسل الأمامي، النظام الخبير، قاعدة المعرفة، PHP، مرض السكري.

1. Introduction

Almost 415 million people have diabetesbut about one-third of them are not aware of their condition(Vallianou2017) With the proper treatment and lifestyle changes, many of the possible complications, such as blindness, amputations, heart disease, kidney failure, and premature death, can be prevented or delayed.

Many people need a tool that can assist them quickly to diagnose the illness according to symptoms that everyone felt. Obviously, this requires a truth result of symptoms that included by patients.

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According to previous survey, users consider that this application will provide a good benefit in helping them, especially for people who live away from doctors and desperately need information as quick as possible. People need an easy tool for them so to build this Web-based information system is appropriate.

Web sites around the world are available and free of access with millions of applications and features. Web site can be built using html and web programming such as PHP, ASP, JSP, JavaScript(Cullen2002) and also the database management can be implemented using MySQL, Oracle, or other database management system. PHP has many advantages among other programming language, it is easy, free of use and powerful to deal with any algorithm while MySQL is the database management system that is also easy, free of use, and reliable to manage millions of data.There for this research is dedicated to develop an application using PHP and MySQL to help users around the world to diagnose themselves to diabetes mellitus. Diagnose process is handled by the Expert System using forward chaining method, because this method will reach and find the goal from a lot of antecedent and suitable for this case.

2. Literature review

2.1 diabetes mellitus

Diabetes mellitus also called DM is a group of diseases characterized by an elevated blood glucose level (hyperglycemia) resulting from defects in insulin secretion, in insulin action, or both. DM is not a pathogenic entity but a group of etiological different metabolic defects (Kumar 2020).

Common symptoms of DM are lethargy from marked hyperglycemia, polyuria, polydipsia, weight loss, blurred vision and susceptibility to certain infection. Severe hyperglycemia may lead to hyperosmolar syndrome and insulin deficiency to life-threatening ketoacidosis.Chronic hyperglycemia causes longterm damage dysfunction and failures of various cell, tissues and organs.

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There was several classification systems established for DM by the WHO Expert Committee on DM (1980, 1985)(World Health Organization 1985). The current WHO classification system has been established in co-operation with the National Diabetes Data Group (USA). It is mainly based on the etiology of DM. The detailed classification are : (1). Type 1 DM: (Immune mediated, Idiopathic), (2) Type 2 DM (3) Other specific types of DM are :

(a) Genetic defects of islet B-cell function.
(b) Genetic defects of insulin action.
(c) Diseases of exocrinepancreas.
(d) Endocrinopathies. (e) Drug- or chemical- induced DM..
(f) Infections. (g) Other genetic syndromes Uncommon forms of DM, (h) Uncommon forms of DM. (4) Gestational DM.

2.2 Expert system

An expertsystem is software that uses a knowledge base of human expertise for problem solving,orto clarify uncertainties where normally one or morehuman expertswould need to be consulted(Tripathi2011). Expert systems are most common in a specific problem domain and are a traditional application andor subfield of artificial intelligence (Isizoh 2021) . A wide variety of methods can be used to simulate the performance of the experthowevercommon to most or all are: 1) the creation of a knowledge basewhich uses some knowledge base structure to capture the knowledge of the Subject Matter Expert. 2) a process of gathering that knowledge from Subject Matter Expert and codifying it according to the structure, which is called knowledge base. 3) once the system is developed it is placed in the same realworld problem solving situation as the human Subject Matter Expert, typically as an aid to human workers or as a supplement to some information system.Expert systems may or may not have learning components.

2.3 Forward Chaining Method

Forward chaining is one of the two main methods of reasoning when using inference rules (in artificial intelligence) and can be described logically as repeated application. Forward chaining is a

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popular implementation strategy for expert system and.The opposite of forward chaining is backward chaining method.

Forward chaining starts with the available data and uses inference rules to extract more data (from an end user for example) until a goal is reached (Kapoor 2016) . An inference engine using forward chaining searches the inference rules until it finds one where the (If clause) is known to be true.When found it can concludethe consequent (Then clause), resulting in the addition of new informationto its data.

Inference engines will iterate through this process until a goal is reached.

For example, suppose that the goal is to conclude the color of a pet named Fritz, given that he croaks and eats flies and that the rule base contains the following four rules:

If X croaks and eats flies - Then X is a frog

If X chirps and sings - Then X is a canary

If X is a frog - Then X is green

If X is a canary - Then X is yellow

This rule base would be searched and the first rule would be selected, because its antecedent (If Fritz croaks and eats flies) matches our data. Now the consequents (Then X is a frog) is added to the data. The rule base is again searched and this time the third rule is selected, because its antecedent (If Fritz is a frog) matches our data that was just confirmed. Now the new consequent (Then Fritz is green) is added to our data. Nothing more can be inferred from this information, but we have now accomplished our goal of determining the color of Fritz.

One of the advantages of forwardchaining method over backwardchaining method is that the reception of new data can make new inferences, which makes the engine better suited to dynamic situations in which conditions are likely to change.

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3. Research methods

To get good research results there are needs to be objectives, the objectives of this research are:

1. Developing a Knowledge Base.
2. Developing Knowledge Representation using Database System.
3. Validating the prototype.

4. Conceptual design

4.1 knowledge representation

Knowledge Representation (KR) research involves analysis of how to accurately and effectively reason and how best to use a set of symbols to represent a set of facts within a knowledge domain. A symbol vocabulary and a system of logic are combined to enable inferences about elements in the KR to create new KR sentences (Tanwar 2010). Logic is used to supply formal semantics of how reasoning functions should be applied to the symbols in the KR system. Logic is also used to define how operators can process and reshape the knowledge. Examples of operators and operations include, negation, conjunction, adverbs, adjectives,quantifiersand modal operators. Interpretation theory is this logic. These elementssymbolsand interpretation theoryare what give sequences of symbols meaning within a KR.

Suppose that P_1, P_2,…,P_n. Where is P_i ($\sum_{i=1}^{n} i$) are the symptoms of diabetes mellitus type 1. These facts can be represented by logical implication of discrete mathematics.

IF (P_1 ^ P_2 ^ P_3 ^ … ^ P_n) ⟶ Diabetes Mellitus Type 1 (Conclusion)

4.2 Database System

Traditionallyknowledge representation systems have been implemented using main memory as the primary run-time storage medium. As a result, the size of a computer's internal memory has placed an upper bound on the size of the knowledge bases that could be loaded. Database management systems on the other hand use

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external storage as the primary runtime storage medium. In contrast to knowledge representation systems the upper bound on the size of a database is not limited by the size of main memory, but rather by the size of external storage. This allows databases to grow to nearly unbounded size given the cost-space trade-offs of disk vs main memory. Knowledge representation systems howeverhave strengths unavailable to normal databasesystems.They allow a complex structural representation of the data (knowledge) that allows inferencing and complex query evaluation to be performed. In addition, relations between data can be recorded as "abstract" relations allowing knowledge about functional relationships, relations between groups of entities, and other such higher-level connections between the ``raw" data elements. MySql is used while recovering the advantages of of DBMS's in particular the efficient storage and retrieval of massive amounts of data.

MySql is a high performance knowledge representation system that deviates from the norm by using a database-management system to provide run-time storage advantages. As a KR system, MySql supports the same representational functionality as its memory-based predecessor.

Database design will consist of four tables: (a) symptoms,

(b) disease, (c) symptoms disease, (d) questions.

4.3 forward chaining method

Inference engines will iterate through this process until a goal is reached as below. Figure (1) shows the Forward chaining method.

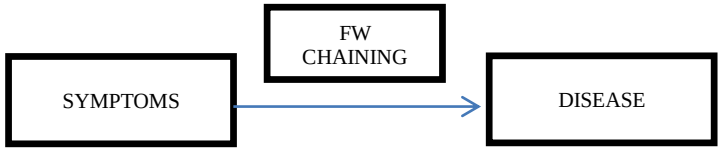

Figure 1.Forward chaining method

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For examplesuppose that the goal is to conclude which type of diabetes illness, given that he has high blood sugar and diabetes historical family, and that the rule base contains the following rules:

If X has high blood sugar - **Then** X is a diabetes illness Type 1

If X has diabetes history - **Then** X is a diabetes Type 2

If X has diabetes - **Then** X is high blood sugar

If X has diabetes - **Then** X is maybe has historical family

This rule base would be searched and the first rule would be selected, because its antecedent (Ifhas high blood sugar) matches our data. Now the consequents (Then X is a diabetes illness Type 1) is added to the data. The rule base is again searched and this time the third rule is selected, because its antecedent (If X has diabetes) matches our data that was just confirmed. Now the new consequent (Then X is high blood sugar) is added to our data. Nothing more can be inferred from this information, but we have now accomplished our goal of determining the type of diabetes.

One of the advantages of forward-chaining over backwardchaining is that the reception of new data can trigger new inferences, which makes the engine better suited to dynamic situations in which conditions are likely to change.

4.4 Managing the knowledge base

A Knowledge Base KB is a special kind of database for knowledge managementproviding the means for the computerized collection, organization, and retrieval of knowledge. Also a collection of data representing related experiences, their results are related to their problems and solutions. KB consists of three type :

1. Machine-readable knowledge bases
2. Human-readable knowledge bases
3. Knowledge base analysis and design

In this research collected information related to the symptoms of the disease and the relationship between diseases that occur.

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Information about the symptoms of the disease is obtained from a medical book or from doctors who are experts in diabetes. Furthermore, the data obtained will be stored in the tablewhich has several tablesamong others:symptoms, disease,questions. Figure 2 shows how information about symptoms of disease be managing.

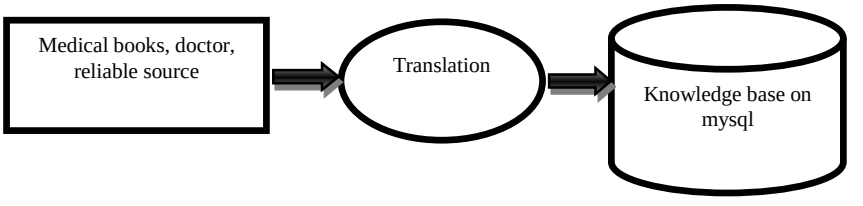

Figure 2. Managing the Knowledge Base

5. Research methodology

Expert systems are a piece of software. Expert systems are similar to conventional software in some respects, but different in others. To build expert systems we must merge new ideas with traditional ones. Often expert systems are only one part of a larger software system. Thus, the development of the expert systems has to be coordinated with other software development. We can draw analogies between the phases in expert systems construction and corresponding phase in software development. The process of expert systems development can be compared with the traditional software lifecycle by identifying five phases in the expert systems construction process. Figure 3 shows these phases.

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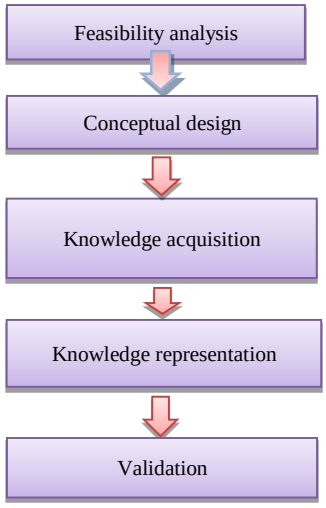

Figure 3. Expert Systems Lifecycle

5.1 Feasibility analysis.

The domain in which the expert system is to operate and the task, which will be performed by the expert systems, are studied and analyzed by the expert systems builder.Identification of an appropriate task is a vital step in the development of any expert systems. The vague sense that an expert system might be useful in a particular knowledge domain is not, in itself, sufficient reason for just justification of the efforts required in building an expert system. The decision about whether to build an expert system should be based on a specification of what tasks will be performed by the expert system and whether or not they meet appropriateneeds.

5.2 Conceptual design

The conceptual structure of the system is defined, along with a specification that describes the way in which the expert system will carry out the task.

In general, the next step, namely, knowledge acquisition, is facilitated by having a good idea of the overall structure of the

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system. A good conceptual design tells the knowledge engineer what to look for and can be used to decide which issues are important and which are not.

5.3 Knowledge acquisition

The knowledge required for performing the task is acquired from human expertscase histories references source etc.

This phase deals with the task of obtaining knowledge and formalizing it so that in can be included in the expertsystem knowledge base. Since expert systems rely heavily on the quality of the knowledge they process.Table 1 and Table 2 contains details of types of diabetes disease and symptoms.

Knowledge Acquisition for diabetes mellitus taken from several books and consulted with the doctor that has experiences on diabetes mellitus.

Table 1. Disease

Code disease	Name of the disease
A	Type 1 dm
B	Type 2 dm

A=Type 1 of diabetes disease & B=Type 2 of diabetes disease

Table 2. Symptoms

No	Symptoms
1	Frequent Urination
2	Excessive thirst
3	Extreme Hunger
4	Unusual weight loss
5	Increased fatigue
6	Irritability
7	Blurry vision
8	Current medications
9	Past medical history
10	Family history
11	Obesity
12	History of cholesterol
13	Hypertension

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14	Occupation
15	Eating Pattern
16	Dietary history
17	BMI
18	Blood pressure
19	Ophthalmoscopic
20	Mouth and Dental condition
21	Thyroid abnormalities
22	Cardiac
23	Abdominal
24	Peripheral pulses
25	Skin condition and edema
26	Foot pin, temperature sensation
27	Fasting plasma glucose
28	Hyperlipidemia
29	Creatinine

As an example when the application started it will provide some questions to the user, i.e.
Are you smoking? Yes/No.
Please write down your weight:
Please write down your height:
How old are you?....etc
These questions depend on the symptoms of the disease.

5.4 knowledge representation

The knowledge is formalized and represented within a symbolic program so that it is executable by the inference engine.
Knowledge must be expressed in the knowledge representation method and the language of the expert systems tool used for building the expert system. This task is facilitated when the form of the knowledge that is captured from the expert correspondence closely to the knowledge structure that is available in the expert system tools.

5.5 Validation

User's views, expert opinions, or operational criteria are used to determine whether the expert system has achieved and acceptable degree of success.

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Intuitively, the aim of a validation effort for any system is to answer the following question: "Does the system works?" In the case of complex systems, however, one should first ask the following question: "Does the system works?" the basic axiom relating to the validation of complex system states:Complex systems cannot be evaluated or validated by using simplistic criteria. The expert system should thus be evaluated using a range of validation guidelines.

Expert system design

After doing knowledge acquisition, knowledge will be store at database; on this research, we use MySql as database system. MySql database will act as a high performance knowledge representation system that deviates from the norm by using a database-management system to provide run-time storage advantages. As a knowledge representation system, MySql supports the same representational functionality as its memory-based predecessor. Table (3) shows the rules.

Table3. Rules table

R no	P1	P2	P3	P4	P5	P6	P7	P8
1	Increased thirst	Frequent urination	Extreme hunger	Weight loss	Fatigue	Blurred vision	Slow healing sores or frequent infections	Areas of darkened skin
2	Increased thirst	Frequent urination	Extreme hunger	Weight Loss	Fatigue	Blurred vision		

1,2=Rules numbers&P1, P2… P8the symptoms of diabetes mellitus type1and type2

Designing the Process

Process designing will explain about how system works to manage input data to the output data with several function provided before. It can be clearly seen that the application will be used by two kind of user; there are administrator and the common user. For Administrator privileges, there is some menu like: add, delete, and update.

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Function of the System

In the system application it uses a lot of different function for user and administrator. At user level will use several function describe below:

a) Adding data

To add disease and symptoms of the disease.

(a)Symptoms, this function located on symptoms.management.php. Function will receive admin data about new symptoms and add to database, located on symptoms table.

(b)Disease, this function located on disease.management.php. Function will receive admin data about new disease and add to database, located on disease table.

b) Deleting data

Deleting data consist of deleting on disease and symptoms tables.

(a)Symptoms,this function located on symptoms.management.php. Function will receive the parameter to delete id_symptoms from passing parameter that had been choosen.

(b) Disease, this function located on disease.management.php. Function will receive the parameter to delete id_disease from passing parameter that had been chosen.

c) Updating data

Updating data consist of symptoms and disease,this function located on symptoms.management.php. Function will receive the parameter to updatewith key id_symptoms from passing parameter that had been chosen.

d) User interface design

User interface is the way to communicate with user and administrator. There are two kind of user interface: (1) for general user, this kind of user will find the information from the system, like the disease according to the symptoms that had been inserted.

(2) For administrator, this kind of user responsible to the content of system, from storing knowledge base until conclusion of application.

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Disease management

Admin can manage disease according to the list of disease stored on database as shown in figure (4).

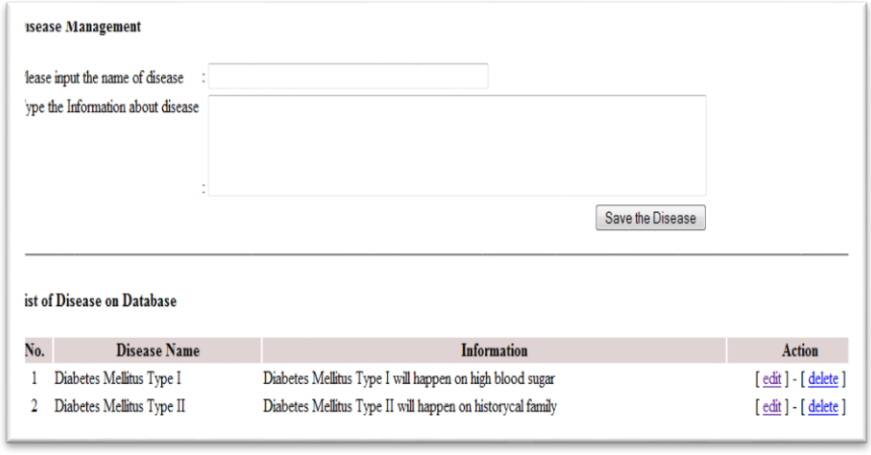

Figure 4. Disease management

Symptoms management

On this page seen in figure (5), admin, can management symptoms by adding or deleting

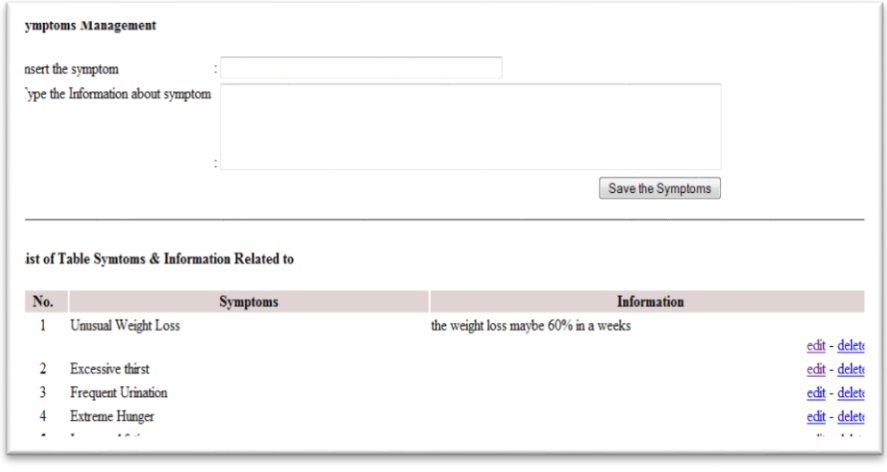

Figure 5. Symptoms management

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Mapping disease and symptoms

Figure (6), the page shows how admin can mapping disease with their symptoms.

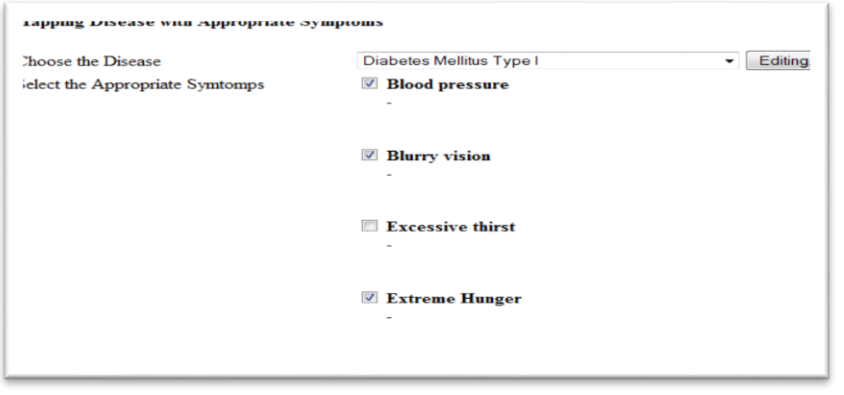

Figure 6. Mapping disease and symptoms

Rule management

On this page of figure (7), admin linking the rules

Figure 7. Rule management

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Try application

Figure (8) shows the user interface, user will answering the questions

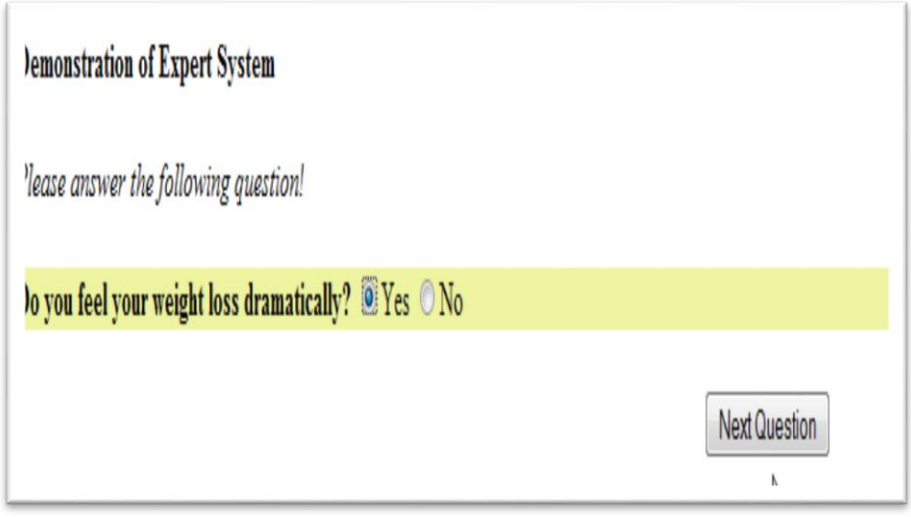

Figure8. Test the application

6. Conclusion

This research focusing on Conducting Knowledge AcquisitionKnowledge Representation and Validation. Expert system using rule base with forward chainingthe reference engines will iterate through this process until a goal is reached. Knowledge Base consists of three type : (1) Machine-readable knowledge bases, (2) Human-readable knowledge bases, (3) Knowledge base analysis and design. Knowledge Acquisition for diabetes mellitus taken from several books and consulted with the doctors that has experiences on diabetes mellitus. Knowledge must be expressed in the knowledge representation method and the language of the expert systems tool used for building the expert system. Knowledge representation for the application of expert system on this research

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is using rulebased knowledge it is according to several research conducted before and the method we are using.

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