

Automated Patient Information Systems for Federal Government Hospitals in Nigeria.

Mary Yerokun,^{***} Boniface Ekechukwu* and Ikenna Ihemelu **

*Department of Computer Science, Nnamdi Azikiwe University, PMB5025 Awka, Anambra State, Nigeria
boni_eke@yahoo.com

** Dept of Information Technology, National Open University, Awka Center

***Dept of Computer Science, Fed. Collage of Education (Tech) Asaba, Delta State, Nigeria.

Abstract

Patient information system has been discovered to be the key contributor to success in the prescription of drugs for major ailments like diabetes and others. This research has discovered difficulties that the medical experts are facing in the aspect of patient information system. The solutions to those difficulties have been considered in the design and development of this automated prescription and patient information system. This work applied the technology of artificial intelligence in combination with the technology of distributed database system for the development of hybrid automated system. The hybrid automated system has been specially designed to be used by Federal Government hospitals in Nigeria. The software is of great importance to medical professionals like doctors, and nurses. In situations where a medical expert is not available, some other medical professionals like young doctors and nurses could consult the computerized expert system for diagnosis and prescription of drugs based on patient information system. The Ministry of Health can easily install this software at the Federal Government hospitals in support of available human resources. The automated system is to assist in management of the database of the patients' particularly diabetic ones [6], [7]. This research applied distributed database system for patient information system. It shows how the query is distributed to the various Informix database servers by a coordinating Informix database server, and how the coordinator reassembles, transforms, and aggregates the intermediate results from the various participating database servers for prescription and patient information system.

Key Words: Diabetes, prescription and patient information system, artificial intelligence, medical expert system

Introduction

Diabetes is a disease that affects an organ of the body, known as Pancreas and others. Thus, it is necessary that it should be detected early enough, and treated. The following are the challenges to the treatment of Diabetes. Limited Medical Experts: Diabetes is a disease that is so sensitive that it requires some level of experience as a medical doctor. There are very limited medical experts who can

diagnose and treat this disease. This software will also assist in managing the limited number of medical experts and to work with high precision. The software makes the data of patients easily available for future use in any federal government hospital through distributed database. It also gives a more accurate result from the test we run and have good data for results obtained. This will reduce the cost of

medical treatment or attention required by patients. Diabetic patients [6] will find this software to be of most importance. This will be of utmost importance to the public. These are people who themselves or their relations undergo countless stress to receive medical attention. These stresses are reduced tremendously by this software. The research applied distributed database system for automated patient information system and prescription of drugs. In distributed database system, the term coordinator is used for the Informix IDS or XPS server that accepts a distributed query from a client. If the query contains references to remote database objects, the coordinator transforms the query into one or more remote queries. Each of these remote queries is sent to the remote database server to retrieve the data for the remote objects. The remote database server is called a participant. The participant treats and processes a remote query from the coordinator just like any query from any database client. In Informix, a remote object such as a table is broadly defined to be an object in another database. This other database can reside within the same database server. A query referencing objects in other databases within the same database server are considered a cross-database query, whereas a query referencing remote objects in another server is considered cross-server. This article does not consider remote object that resides in another database within the server as remote objects. These objects are merely organizational in nature and are no different from the objects in the local database when it comes to their access. In another words, a distributed query in this article means a cross-server query exclusively.

Background Studies

The field of artificial intelligence research was founded at a conference and the campus of Dartmouth College in the

summer of 1956. The attendees, included John McCarthy, Marvin Minsky, Allen Newell and Herbert Simon,[Ref] became the leaders of AI research for many decades. They wrote programs that were solving world problems in algebra, proving logical theorems and speaking English. AI founders were highly optimistic about the future of the new field. Herbert Simon [] predicted that “machines will be capable within twenty years, of doing any work a man can do”.

In 1974, the U.S.A and British governments cut off all exploratory research in AI. When funding for project was hard to source, led to what would later be called an ‘AI Winter’.

In early 1980s, AI research was revived by the commercial success of expert systems; a form of AI had reached over a billion dollars. However, the collapse of the Lisp machine market in 1987, AI once again fell into disrepute and a second, longer lasting AI Winter began.

In the 1990s and early 21st century, AI achieved its greatest successes, Albert somewhat behind the scenes. Artificial intelligence is used for logistics, data mining, medical diagnosis and many other areas throughout the technology industry. The success was due to several factors, namely: The incredible power of computers today; Greater emphasis on solving specific sub problems; The creation of new ties between AI and other fields working on similar problems; A commitment by researchers to solid mathematical methods and rigorous scientific standards.

Since the discovery of artificial intelligent system, it has grown and become useful in almost all aspects of human endeavor. For this research we will particularly consider artificial intelligent system in the field of medicine. Several medical artificial intelligent systems have been developed, but we will consider just few.

Smart Doctor: “Smart Doctor” was developed by Dr. Anthony Sforza [3]. He had stated that “knowing the frustration and inefficiency in documentation and billing for small practices”, there arose the need “to develop a simple, easy-to-use system that would reduce the burden on practicing physicians while improving the quality of patient’s care”. Thus the main objectives for developing this AI system include:

- To reduce inefficiency in documentation of patient’s data;
- To improve the billing system for small practices;
- To reduce the burden on practicing physicians;
- To improve the quality of patient’s care with high precision.

Diabetes is a condition in which a person has a high blood sugar, either because the body does not produce enough “insulin”, or because cells do not respond to the insulin that is produced. This high blood sugar produces the classical symptoms of “Polyuria” (i.e. frequent urination), polydipsia (increased thirst) and “polyphagia” (increased thirst). This computerized system will permit users to only diagnose a patient of diabetes and recommend appropriate drugs. This system is highly recommended because of its importance, which include: elimination of the long procedure of diagnosis and treatment. The system is designed to solve the challenge of limited medical practitioners and to help the medical practitioners in quick decision making.

Materials and Methods

A natural language procession system can be used to retrieve important information without typing in commands or searching for key words. With natural language processing, it is possible to speak into a microphone connected to computer and have the computer convert the

electrical impulses generated from the voice into test files on program commands. With some simple natural language processors, you say a word into a microphone and type the same word on the keyboard. Learning system: Another part of artificial intelligence deals with learning systems, a combination of software and hardware that allows a computer to change how it function or react to situations based on feedback it receives. Examples of learning systems are computerized games. Learning systems software requires feedback on the results of actions or decisions. At a minimum, the feedback needs to indicate whether the results are desirable (winning a game) or undesirable (losing a game). The feedback is then used to alter what the system will do in future. This technology of artificial intelligence is considered suitable to be combined with the technology offered by distributed database system.

The technology of distributed database system is considered in this research as to enable application of distributed queries to various participants which include various federal government hospitals in Nigeria. A distributed query, as compared to a standard non-distributed one, is more susceptible to certain inefficiencies in a query plan. This is not only because of the overhead in compiling and processing the extra queries by the participants, and the cost incurred for the transportation of intermediate records between servers over longer distances and slower network protocols, the repetitive nature of join processing tends to have a multiplicative effect on these additional costs. Furthermore, such degradation is exacerbated when a multi-phase commit protocol is used to handle DQ involving updates. In other words, in a non-distributed environment, the impact of certain inefficiencies may not be noticeable as compared to a DQ. This part of the article examines some of the critical ones and provides solutions to them.

This research made use of vital part of Artificial Intelligence that is made up of hardware and software that store knowledge and make inference, similar to human experts. An expert system behaves similar to a human expert in a particular field. Computerized expert systems have developed to diagnose problems, predict future events and solve them energy problems. They have also been used to design new products and systems, determine the best use of a product and increase the quality of healthcare. Like human experts, computerized expert system uses heuristics or rules of thumb, to arrive at conclusions or make suggestions. Expert systems have also been used to determine credit limits for credit cards. The research conducted in Artificial Intelligence (A.I) during the past two decades is resulting in expert systems [4] that explore new business possibilities, increase overall profitability, reduce costs and provide superior service to customers and clients.

The research methodology used in this research is made to provide us with: A well defined means of studying and developing a system. The approach of handling, naming, and manipulating data. The set of tasks to be carried out in certain stages and documentation. The system approach used recognizes that every system has an objective, a set of components and set of interrelationship among components. This design is to find the sources of problems with the existing system and prefer solutions to such problems. The simple techniques used are random techniques which give every elements in a sampling area, equal and independent chances of being selected in the sampling of same hospitals. The tools used for data collection includes the following are interview, observation, textbooks and journals.

Building an expert system is known as knowledge engineering and its practitioners are called “knowledge

engineers”. The knowledge engineer must make sure that the computer has all the knowledge needed to solve a problem. The knowledge engineer must choose one or more forms in which to represent the required knowledge as symbol patterns in which to represent the required knowledge as symbol patterns in the memory of the computer that is, he/she must also ensure that the computer use the knowledge effectively by selecting from a handful of reasoning methods.

System Design and Implementation

System design is the process of planning a new business system or one to replace or complement the existing system. It is necessary to have a proper understanding of the old system, which is seen in our present day hospitals or health care center. This project will then help determine how computer can best be used to make an effective change in the operation of the present day hospital activities [5]. The system will help in easy access to stored files and records. It would be easier and faster for computer to access and retrieve stored patient’s files and records even in different federal government hospitals. Higher security is maintained. This will make it impossible for an authorized user to have access, since the system uses password for logging in. This system will help in the backup of files and records. In cases of loss, it is always easy to reload such records from the backup disks, diskettes and tapes. It will be a dynamic database management system. It will also help in speedy diagnosis of diabetes and prescription of drugs.

The problem solving model or paradigm organizes and controls the steps taken to solve the problem. One common but powerful paradigm involves chaining of IF-THEN rules to form a line of reasoning. If the chaining starts from a set of conditions and moves toward some conclusion, the method is called “chaining”. If the condition is known

(examples, a goal to be achieved) but the part to that conclusion is not known, then reasoning backwards is called for, and the method is called backward chaining. These problem-solving methods are built into programs modules called inference engines or inference procedure that manipulate and use knowledge in the knowledge to form a line of reasoning. The most important ingredient in any expert system is knowledge. The power of expert system resides in the specific, high-quality knowledge. They contain about task domain. Knowledge is almost always incomplete and uncertain. To deal with uncertain knowledge, a rule may have associated with it to a confidence factor or a weight. The set of methods for using uncertain knowledge in combination with uncertainty is called “fuzzy logic” and the system that use them are known as “fuzzy systems. Human experts need a way of communicating with source of information which is their clients. This allows them for particular details of a problem and shares their conclusions with clients similar. Experts systems interact with users through a user interface that allow users to query the system supply information. the user interface aim to provide the same form of communication facilities provide by the human but often has much less capacity understanding natural language and general world knowledge.

Building an Experts System

The processes involved in the building of an experts system include: Identification of problem for an experts system. If it is possible, it is appropriate for an experts system to break down the problem into pieces. Select the tools or implicitly commit yourself to a particular consultant paradigm. Find the main knowledge concept and the problem solving strategies. Design an overall structure to organize the knowledge for ancient solving. Initially this process involve in describing the system on paper, it typically

involves making flow diagrams and drafting a few rules. Develop a prototype of the system using the tools. This involves putting the knowledge base and problem solving strategies into rules encode them into a computer language. Test the prototype expert system against cases with known outcome and defined the rules. Operate the newly graduated expert system on a real problem. Maintain and upgrade the system as require, expanding it capabilities and even major revision can continue indefinitely.

Database Design for Patient Information System in Federal Government Hospitals

Databases are extremely common in businesses. The ordinary database is typically held on a central server and people log in to the system to query or update the database. However, there is another type of database - known as a distributed database - that offers advantages for some types of organization. A distributed database is a single logical database whose parts are physically located in more than one place, each location is accessible across a network .Many organizations have branches and offices located across the country or even the world. It may be that each branch only needs to access their own data 90% of the time and only occasionally have a need to access remote information. On the other hand the central office needs to have an up to date version of all the data as well. With a single central database, all queries and updates have to travel across a network. This may cause a heavy load on the system. It also means if the central database breaks or the network goes down, the entire organization is affected. A distributed database solves some of these issues. With a distributed database, the central database is updated over night as a batch operation, but day-to-day work in the branches is carried out using the local portion of the database. If the network

fails, then they can carry on as normal until it is fixed. Three types of distributed database update are presented: Duplicated database at each location. With this system, a local copy of the entire database is kept at each location; Partitioned database, the distributed database is split or 'partitioned' into convenient data sets depending on the specific needs of the organization; Partitioned + index, this is a modification of the partitioned database to include an index of all remote database records as well; Updating Distributed Data, two updating distributed data techniques are involved as discussed namely: Synchronous Replication: All copies of a modified relation (fragment) must be updated before the modifying Xact commits and data distribution is made transparent to users. Asynchronous Replication implies that copies of a modified relation are only periodically updated; different copies may get out of synchronization in the meantime. Users must be aware of data distribution while current products follow this approach.

Distributed database [1] update in modification process may affect both global sites and or just the local (remote) site where the transaction has taken place.

Database Query for Prescription and Patient Information System

Queries about prescription and patient information system are distributed to the various Informix database servers by a coordinating Informix database server, and the coordinator reassembles, transforms, and aggregates the intermediate results from the various participating database servers in various Federal Government hospitals. The results for the remote queries are returned by the participants, and the coordinator is responsible for consolidating and joining the results. The coordinator may also have to transform, sort, and aggregate these results before returning the final answers to the user. The figure below shows the flow of the query from the user to the remote queries issued by the coordinator to the participants [2].

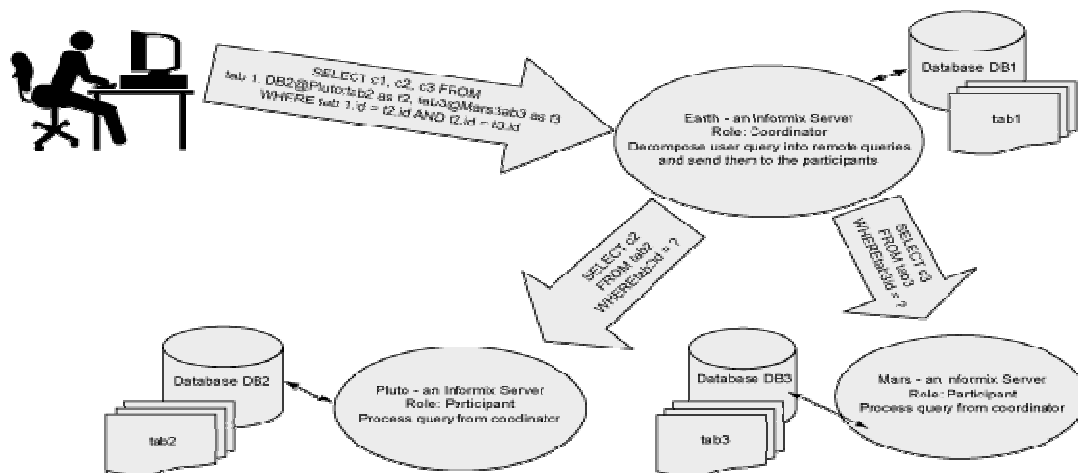


Fig. 1: DBMS procedural operations

Database management involves the monitoring, administrating, and maintaining of the databases and database groups in an enterprise which involve

managing and structuring the collection of data held on computers. The figure below shows the flow of the results returned by the participants to the user.

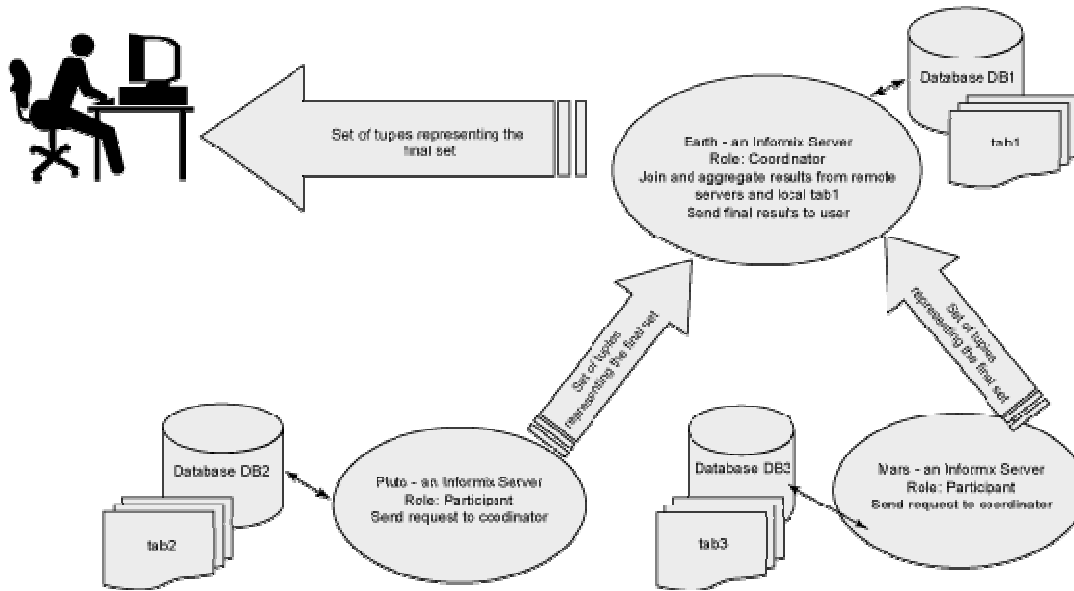


Fig. 2: Flow of the results returned by the participants to the user?

Results and Discussions

On the requirement of patient information who has registered with any federal government hospital, the patient’s database identification will be used to extract the past patient’s history stored in the previous federal government hospital

attended by the patient. Expert System is interactive in nature. The system through this interactive process diagnoses the patient’s ailment after comparison of patient’s information in the database with present symptoms.

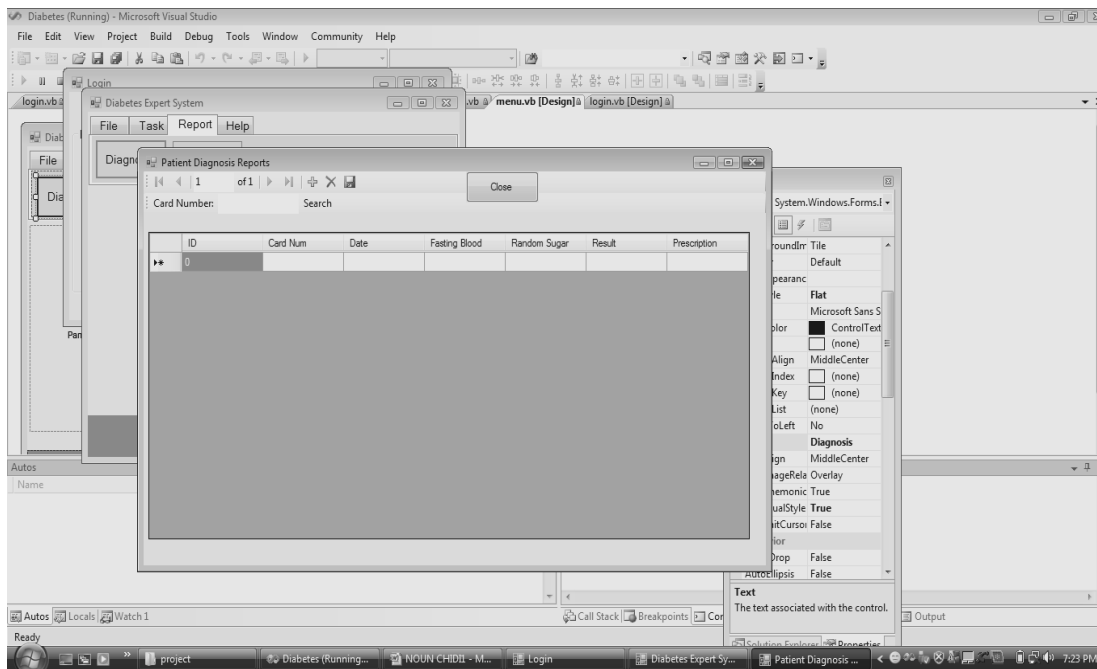


Fig. 3: The menu screen

A *distributed update* modifies patient information on two or more Federal Government Hospitals. A distributed update is possible using a PL/SQL Sub-

program unit, such as a procedure or trigger that includes two or more remote updates that access patient information on different Federal Government Hospitals.

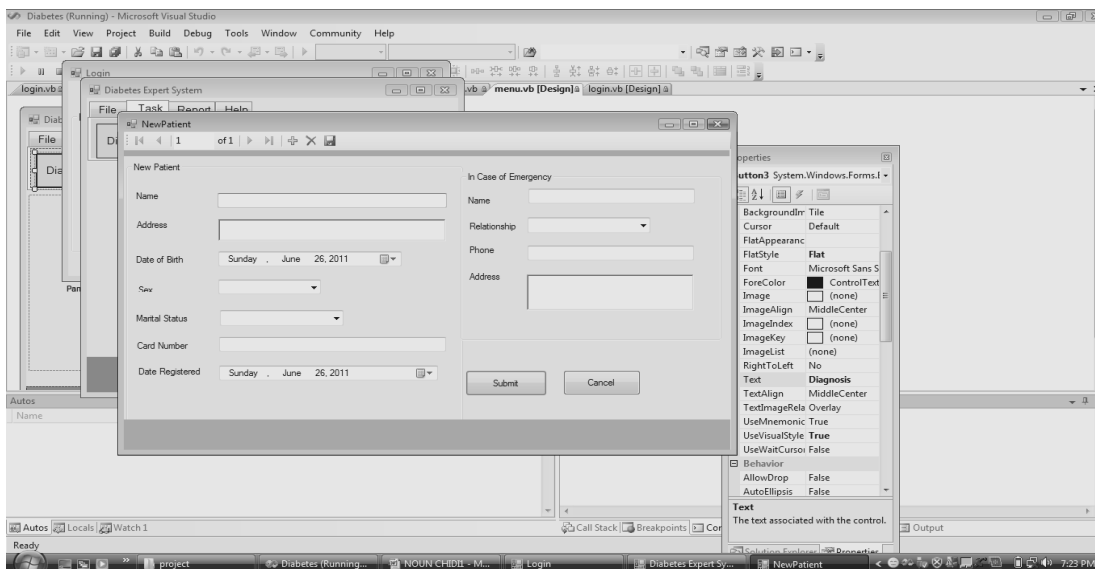


Fig. 4: Input Screen

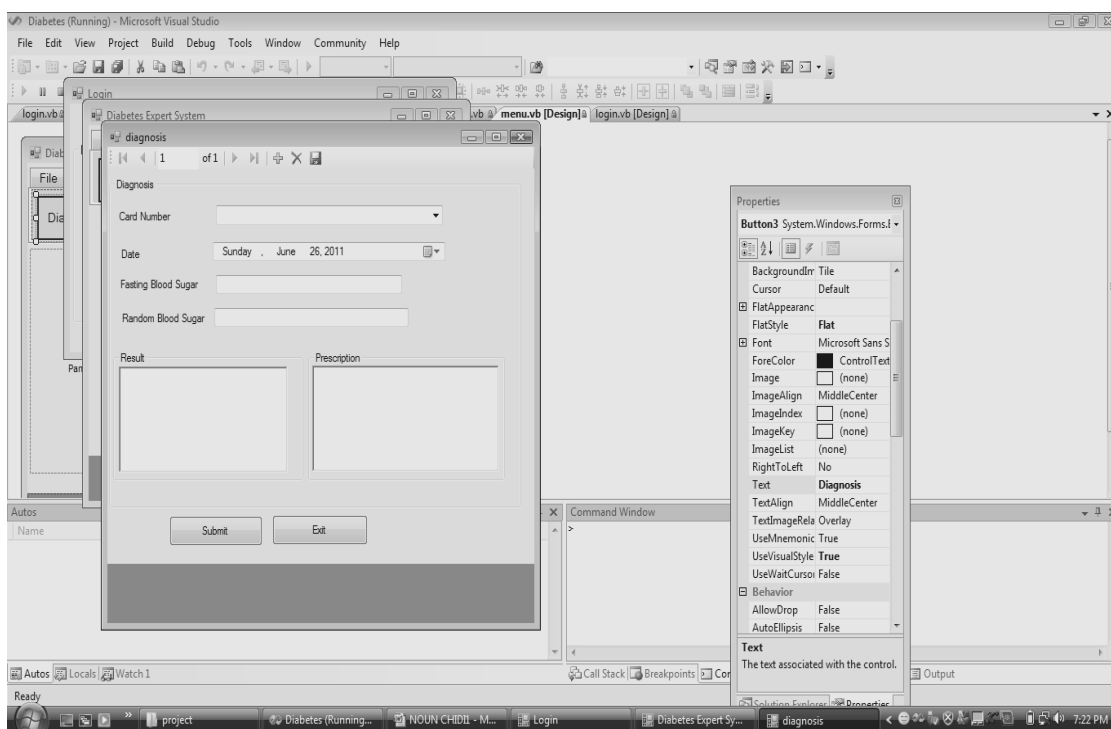


Fig.5: Another Input Screen

References

- [1] M. T. Özsu and P. Valduriez, (2011) *Principles of Distributed Databases* (3rd edition), Springer, [ISBN 978-1-4419-8833-1](#)
- [2] Elmasri and Navathe, *Fundamentals of database systems* (3rd edition), Addison-Wesley Longman, [ISBN 0-201-54263-3](#)
- [3] Control, *Cervical Cancer Screening in Developing Countries (2002): Report of a WHO Consultation*, Geneva: World Health Organization, 2002. As of August 24, 2011:
- [4] *Expert System and medical Issues* Thomson Learning. pp. 741 pages. [ISBN 0-324-06188-9](#).
- [5] French,C.S.(1993).*Data processing and information technology*” Dp publication Ltd, London.
- [6] Gregory Hastings, Nejhdeh Ghevondian, “*A self-organizing estimator for hypoglycemia monitoring in diabetic patients*”, 20th annual international conference of IEEE engineering in medicine and biology society, Vol. 20, No 3, 1998.
- [7] T.Jayalakshmi and Dr.A.Santhakumaran, “*A novel classification method for classification of Diabetes mellitus using artificial neural networks*”. 2010 International Conference on Data Storage and Data Engineering.