ANALYSER INTERFACE WITH MEDICAL LAB INFORMATION SYSTEM

PROJECT WORK DONE AT
CONSOLIDATED CYBERNETICS CO. PVT.LTD

PROJECT REPORT
SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF
MASTER OF COMPUTER APPLICATIONS
OF BHARATHIAR UNIVERSITY, COIMBATORE

P-1030

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May 2003

CERTIFICATE

This is to certify that the project work entitled

ANALYSER INTERFACE
WITH MEDICAL LAB INFORMATION SYSTEM

Submitted to the

Department of Computer Science and Engineering

Kumaraguru College of Technology

in partial fulfillment of the requirements for the award of the degree of Master of Computer Applications is a record of original work done by **Umamaheshwaran.A.** **Reg.No.0038M1071** during his period of study in the Department of Computer Science and Engineering, Kumaraguru College of Technology, Coimbatore under my supervision and this project work has not formed the basis of award of any Degree/Diploma Associateship/Fellowship or similar title to any candidate of any university.

Professor and Head

Staff-in-charge

Submitted for University Examination held on 16/4/2003

Internal Examiner

External Examiner 15/4/03

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CERTIFICATE

This is to certify that the project report tilted, **"Analyser Interface with Medical Lab Information System "** which is being submitted by **Mr. A. Uma Maheshwaran** in partial fulfillment of the requirements for the award of the degree of **Master Of Computer Application** is a bonafide work carried out by his under the guidance of **Mr. S. Shanmugavel, Sr. Software Engineer**, at Consolidated Cybernetics Co. Pvt. Ltd., Coimbatore during the period December 2002 to April 2003 to our satisfaction.

His punctuality, behavior, conduct and progress in training was good as rated by the department

His attendance is 97%

For **CONSOLIDATED CYBERNETICS CO. PVT. LTD.,**

S. Shanmugavel.

S. SHANMUGAVEL
SR. SOFTWARE ENGINEER

DECLARATION

I hereby declare that the project entitled , **'ANALYSER INTERFACE WITH MEDICAL LAB INFORMATION SYSTEM'** for Consolidated Cybernetics Co. Pvt. Ltd., , submitted to **Kumaraguru College Of Technology,Coimbatore** affiliated to **Bharathiar University** as the project work of **Master of Computer Applications Degree ,** is a record of original work done by me under the supervision and guidance of **MR.S.Shanmugavel BE Software Engineer ,** Consolidated Cybernetics Co.Pvt. Ltd., and **Mr.A.Muthukumar ,MSc.,M.Phil., Lecturer , Kumaraguru College Of Technology,Coimbatore** and this project work has not found the basis for the award of any Degree/Diploma/Associateship/Fellowship or similar title to any candidate of any university.

A. Umamaheshwaran

Signature of candidate

(Umamaheshwaran . A.)

Place : Coimbatore

Date : 7/4/2003

First and foremost, I am grateful to God Almighty, who has showered his blessing on me throughout this project.

I'm extremely indebted to **Dr. K.K. Padmanaban Ph.D.,** *Principal, Kumaraguru College of Technology, Coimbatore,* for having given me the prestigious opportunity of being a member of this institution.

I find no words to express my deepest sense of gratitude **Dr. S. Thangasamy Ph.D.,** *Head of the Department, Computer Science and Engineering, Kumaraguru College of Technology,* for giving me the golden opportunity to do this project.

I deem it a great privilege to have **Prof. Mr.A.Mutuhukumar, MSc.,M.Phil.,** *Department of Computer Science and Engineering* as my internal guide and I wish to thank him for his able guidance, support and interest taken in my project.

I owe my affectionate thanks to the company director **Mr.Rangaswamy BE,MBA.,** and my company guide Senior software engineer **Mr.S.Shanmugavel BE.,** for their valuable suggestions and timely encouragement throughout the project.

Umamaheshwaran.A

The project "Analyser Interface With Medical Lab Information System" was done for Hi Tech Laboratory, Coimbatore under the guidance of Consolidated Cybernetics Co. Private Ltd, Coimbatore.

The project consists of modules like,

- *Interface establishment*
- *Combination selection*
- *Disease prediction*

- ***Interface establishment module*** deals with the establishment of communication path between the computer machine and the electronic equipment .This is accomplished with a 25 – 9 pin cable and with the registers AX , BX , and DX. The sort of pins that are used are SG , TX ,RX,RTS,CTS ones.
- ***Combination selection module*** deals with the biological tests that are done in the electronic equipment.These results are collected through the interface and based on the serum and plasma levels the tests that are to be combined are determined.The technique called as single layer perceptron in neural nework technology is used to determine the combination.
- ***Disease prediction module*** deals with the resultant value of the tests that are evaluated after the combination phase .This is done through multi layer perceptron technique which is prone to neural network technology.The information that are gathered through this analysement and additional information are also needed to predict the disease in a right way.

1. *Analyser Interface with Medical Lab Information System*

1.1 *Definition*

This project is a domain range of activities that are carried out in a medical laboratory in order to access the biological condition of the human beings.

It includes the separation of human blood into serum and plasma .This serum and plasma of the blood are analysed through some tests using chemical reagents and based on the reaction of the blood to the chemical reagent,the resultant value is estimated.The tests that are carried here are very much biological oriented i.e)more detailed ones, and in order to get the test results like sugar which is more generalized we must combine some set of tests and get the resultant value.These analysement through tests with chemical reagents are done by an electronic machine called as Vitaanalyser a German equipment expect the combination part.

Therefore, the tests that are carried out in the analyzer are to be brought to the computer machine with the help of an interface mechanism and the tests that are to be combined must be determined (which varies person to person),and the resultant value must be evaluated.

Based on the final value for the generalized tests the disease is to be diagnosed and the report must be generated with the anlaysed informations.

1.2 *Benefits*

- No human intervention is needed
- Saving Time and faster result production
- Direct benefit to the physicians
- No error prones in testing

2.1 *CCPL – A profile*

Consolidated Cybernetics is a leading Software house based at Coimbatore, premier industrial city in Southern India, promoted and managed by IT Professionals.

Established in 1993 as D I G I T A L (DEC, USA) Authorized Training center,Consolidated Cybernetics offers high end training for the Professionals. (both students practitioners). Cybernetics had been the Associate of Digital from 1993 to 1998. Cybernetics had also tied up with PSG College of Technology and ORACLE for the education business.

High Quality Standards have been maintained to meet the requirements of the world leaderDigital Equipment Corporation USA. Our association is a testimony for the quality education we could offer. Consolidated Cybernetics was also DOEACC (Dept. of Electronics, Govt. of India)accredited Center for offering 'O' Level course.With an unwavering focus on quality,Consolidated Cybernetics has setup the task of being the standard of excellence in everythingit does. In fact quality is an obsession at Consolidated Cybernetics.

3.1 *Existing System*

The system which exists was very manual as all the processes are to be performed manually.

Whenever the testing is to be done for a human , the blood sample is got and they manually replace the serum and plasma from the blood using some circular hanger .The separated serum and plasma are given as the input to the electronic equipment and the results are to be gathered manually after the tests are conducted.

Then , the combination must be determined based on the results and these combined set must be taken explicitly and manully must workout the resultant value.At last,they predict the disease based on the evaluated results and this relies mjorly on the knowledge of the specific microbiologist who is working at that point of time and the final reports are created which carries the manual invention.

3.2 *Limitations of existing system and enhancements made in the proposed system*

The proposed system overwhelms the current manual processing system with time, flexibility and user friendliness as the key features in it.

The existing system are very much relied on a big hallucination and as this decides the disease for the human where the probability of correctness must be 100 percent but it just falls around 90 percent only.

By the proposed system the accuracy of data intervention are maximum and the usage of time is also very much less and no major contribution of employees are needed here.So ,ultimately it reduces the employees and there by money is saved in a huge proportion.

3.3 *Problem Statement*

The project consists of 3 modules as follows:

Interface establishment module

This module establishes a communication path between the electronic equipment and the computer machine.

This is made possible using 25- 9 pin cable as 9-pin end is for the computer machine and 25 pin end for the electronic machine as the circuit is able to accept only 25 pin cable . The port that are used are RS 232A and RS 232B ports.The device id that is applied here is 1 since it's the static setting by the developer of the electronic equipment.The communication setting is set to 9600,N,8,1 in the electronic equipment which is respect to the computer machine settings.The status are made to be 'on-line' in the electronic machine at the time of data transaction and at others it is 'off-line'.

The other modules in this part are :

* Init
* Status
* Send
* Recv

- Init
  - Used to initialize the serial port.
  - The register 'AX' is set with value '0x00ff' which specifies the port parameters. The register 'DX' is set with value '0' or '1' for COM PORT 1 0r 2.The int86( ) function is called to invoke the 8086 interrupt INT 14H.
- Status
  - Used to get the serial port status.
  - Here the register 'AX' is set with value '0x0300'. The register 'DX' is set as per the port. Then, the interrupt 14H is invoked using int86( ) to get the status. This function returns the status value stored in 'AX' to the calling function.
- Send
  - Used to send a character to specified serial port.
  - Here at first the status is read from the port using status( ) function.
  - If the 'transmission buffer register empty' bit is set then character to be sent is placed in the 'AL' register. The value '0x01' is set in 'AH' register.
- Recv
  - Used to receive a character from the specified serial port.
  - The register 'AH' is set with '0x02', 'DX' is set as per port used and the int86( ) function is called to generate the interrupt 14H. This returns the character received from COM PORT.

The port format is set by the electronic machine which is unmodifiable and the sample format look as

```
STX {
        R;device_id(4);
          type(1);
        Id_nr(12);Sample_name(20);date_of_birth(11);sex(1);
        nr_of_tests(2);

test_name(4);result(7);flags(22);units(6);serum(5),plasma(5)
                        } ETX CR LF
```

The pins that are used for the above manner of communication include :

7	SG	Signal Ground	
2	TX	Transmit data	output
3	RX	Receive data	input
4	RTS	Request to send	output
5	CTS	Clear to send	input
20	DTR	Data Terminal Ready	output
6	DSR	Data Set Ready	input
8	CD	Carrier Detect	input
22	RI	Ring Indicator	input

Combination Selection module

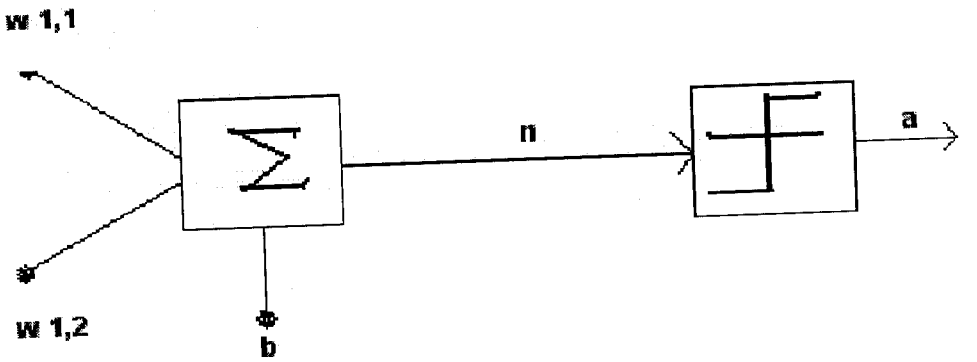
This module determines the combination among the available tests.

The sample of a human blood will be given as the input to the electronic machine after the separation of serum and plasma .This is placed in the tray provided by the electronic machine and the hole to place the test tube in the tray will be informed through the monitor by the electronic machine.And based on the tests that are to be carried out the chemical reagents are selected and their corresponding reaction are noted and with respect to the colour that the blood is turning out after the mixture of chemical reagent the value is evaluated with the respective units.This is the work load of the electronic equipment.

This tests , their results and the serum and plasma level which is there in electronic equipment after the tests are collected to the computer machine through the inferface module by having status as 'on-line'.Based on the serum and plasma level and using the single layer perceptron method we determine the combinations available.

The structure of the perceptron model is:

Single neuron architecture(a part)



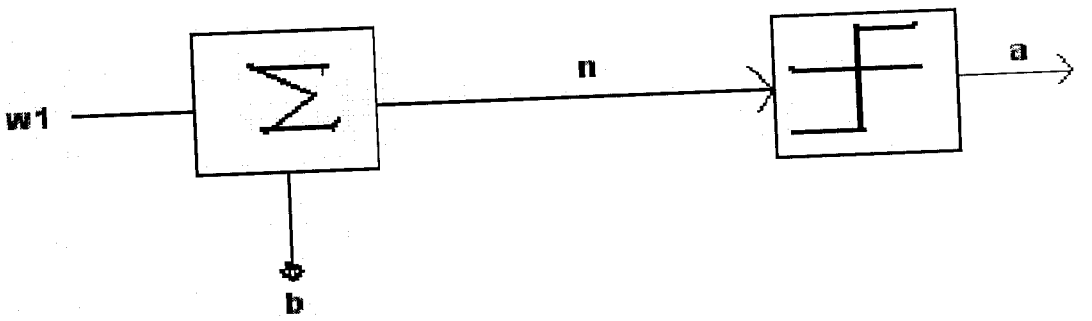
For w 1,1 : Serum range of a test ; For W 1,2 : Plasma Range of a test

Range is within : w 1,1 = 1 else w1,1 = -1 ; |||y, for w1,2

Mulitply(w(1,1) , w(1,2)) > -1 ; go to the threshold function ; common value collection

(w(1,1) , w(1,2)) <= -1 ; go to the other neuron;

Single neuron architecture(b part)



For w1 : the test range value is checked

if the value is within ; w1 = 1 ; else w1 = -1;

n = multiply (w1 , b)

n = 1 ; test value is collected and send to the MLP;

n = -1; threshold function;checks for the abnormal condition;yes;send MLP;

no;discard

- *Supervised Learning*

In supervised learning algorithms , the input and target pairs given for learning.It is perhaps the most typical neural net setting , where training is accomplished by presenting a sequence of training vectors or patterns , each with an associated target output vector.The neural network is driven in guided path to attain the goal.

These supervised learning algorithms can provide a better solution for identification of component invariant of orientation.

By these process manners,the combination of tests are found out from the set available and these combination derived will not be the same at all times since it differs from person to person.

Disease prediction module

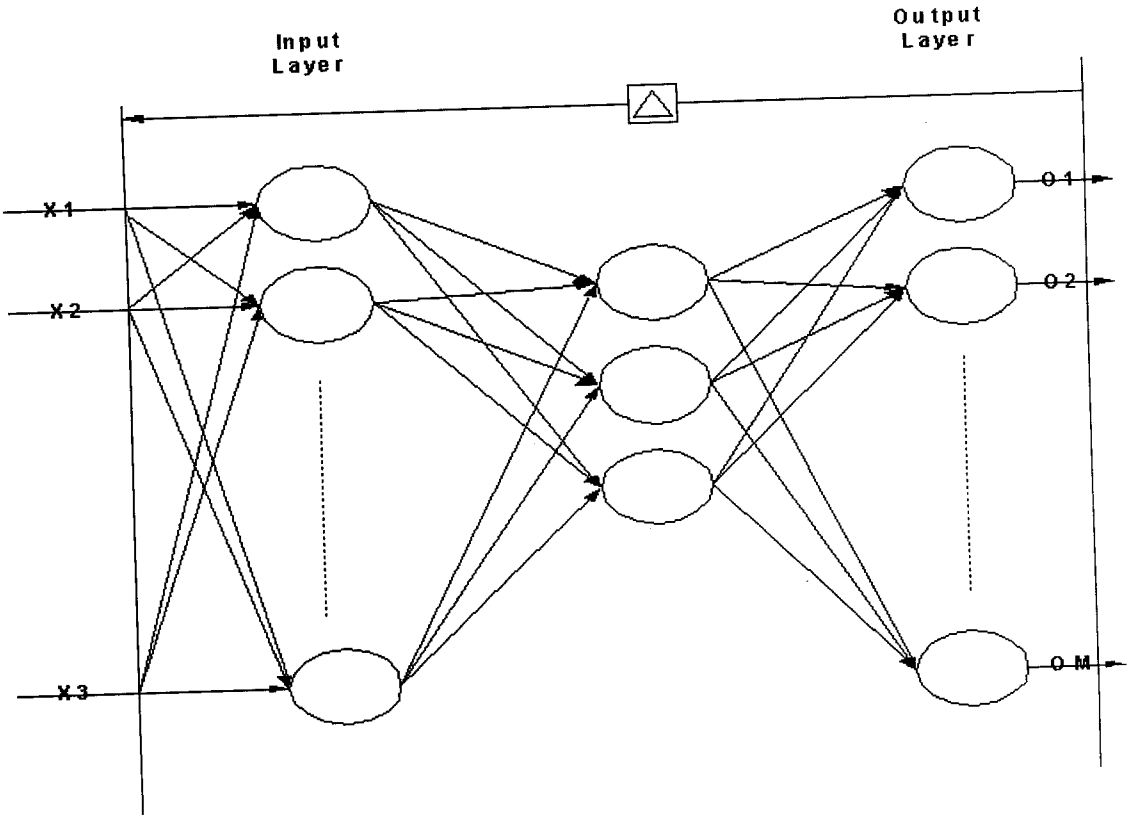
This module deals with the results of generalized one which are extracted from the above module.

These diagnosis of diseases are made possible with the help of Multi layer perceptron of neural networks.Multi layer perceptrons are one of the most popular nets consist of multiple layers of simple processing elements analogous to biological neurons .In the widely used MLP technology,neurons are fully interconnected to all the neurons in the next layer.

The connections are characterized by weights .Each of the neurons adds up the product of weights and corresponding output carried by all the connections to the neuron.The neurons produce an output as a function of the input. These is the functional mannerism of the multi layer perceptron.

The architecture of multi layer perceptron is specified as follows.

Multi layer perceptron architecture:



Here, the output that produces will be of an numerical one. Thus value then be mapped to the disease that it represents.

- *Delta Learning*

These architecture is been trained using delta learning rule which explains as:

$$W_{ji} = n(T_j - O_j)O_i$$

where w_{ji} is the weight from unit j,n is the learning rate,O_i and O_j are the activation levels of units i and j,and Tj is the desired activation level of unit j.

The activation function is derived as:

" $f'(net) = derivative\ of\ f(net)\ i.e.,\ multiply(weight(w_{ij}), x)$ "

The weight adjustment is made as:

" $w = (di - oi)f'(net)x$ "

di and oi are the different outputs.

3.4 *Processing Environment*

3.4.1 *Development Environment*

Needs	Tools Employed
Data Storage	C++ Files Structures
Programming Tool	C++ language
Learning script tool	C language
Special processor	NEC V20

3.4.2 *Implementation Environment*

Needs	Tools Employed
Operating System	Windows 98
Class of language	Turbo c,c++
Computer pin structure	9 pins
Communication settings	9600,N,8,1

3.4.3 *Protocols*

Designed by the developer of the electronic equipment and must use the same .

3.4.4 *Hardware Constraints*

- Pentium III 450MHz
- 20 GB HDD
- 128 MB RAM

3.5 *User Characteristics*

No experience is required for the user except he / she should have some knowledge about the biological oriented ones.

PROJECT PLAN & FEASIBILITY STUDY

1 *Development Schedule*

1.1*Milestones*

Milestones are being established for each and every module to improve the product visibility. It enhances the development process to become more tangible. It exposes errors, which help in improving the product quality and increases project communication. In our application it has been done sub module wise.

4.1.2.*Reviews*

The review summary report is prepared on weekly basis to know the progress of each member. Review issues lists are prepared to identify problem areas within the product, which are attached with every review summary.

4.2 *Manner of Demonstation*

The programmers first do the demonstration of the product to his/her system and later the senior programmer integrates all the sub modules and demonstrates to the team manager as a complete package in the multimedia projector.

4.3 *Feasibility Analysis*

The feasibility study is very rough analysis of the viability of a project. It is however a highly desirable checkpoint that should be completed before committing more resources. A feasibility study is conducted to obtain an overview of the problem and to roughly assess whether feasible solutions exist prior to committing substantial resources to a project.

Before the project commenced a study was undertaken in the organization to ensure that the project is feasible to be developed and implemented in the organization. As this project is done for a laboratory which is risking a humans life all care was there by most of the engineers at CCPL .

The primary objective of a feasibility study is to assess three types of feasibility:

- Operational Feasibility
- Technical Feasibility
- Economical Feasibility

4.3.1 *Operational Feasibility*

Operational feasibility study is a must, because it ensures that the project implemented in the laboratory works. This feasibility should be high.The operation feasibility of this project is optimal as it is automates the manual processes through the techniques of neural networks.

4.3.2 *Technical Feasibility*

The Technical feasibility analysis makes a comparison of the level of technology available and the same required for the development of the product. The level of technology accounts for factors such as the programming language, the machine environment, the programming practices and the software tools. It includes the study of function, performance and constraints that may affect the ability to achieve an acceptable system. The following considerations are evaluated with technical feasibility.

Resource availability such as Pentium III processor with 128 MB Ram, software and tools requires for the project is available at the laboratory. Hence it is technical feasible.

4.3.2 *Economic Feasibility*

This is the most important aspect that has to be critically evaluated. This includes the feasibility study of cost-benefit analysis. This is an assessment of the economic justification for a computer-based project. The hardware and most of the software are already there in the laboratory.

And moreover the CCPL engineers aims to show the revenue with less amount spend for IT to the director. So they have decided to use free distributed and trust worthy softwares like Windows operating system, and turbo C and C++.

Hence the threat of financial non-feasibility does not exists. It is determined that benefits out beat the cost of implementation and thus the system is considered to be economically feasible.

4.4 *Non Functional Requirements*

4.4.1.*Reliability*

Reliability of the system depends on the amount of load that the electronic equipment has and the amount of communication lines that are present at that point of time.

4.4.2 *Testability*

The application is developing in a modular way the testability is high. Internal code reviews and functional test will conduct on each module. Also functional points and test cases for each module will be prepared. Unit testing is required for each module and an integration testing should be done for the entire system. Functionality test should be carried out after the integration of the entire system. The validation test is done on both the electronic equipment and the computer machine using some sample datas.

4.4.3 *Maintainability*

Since the design and coding will be properly documented the maintability of the system will be high.

4.4.4 *Portability*

Since the application is running on a popular windows platform successfully,it can be transferred to any other system which has windows compatibility.

SYSTEM DESIGN

5.1 *Database Design*

- Table name : Standard Table
- Purpose : To store the legal levels of serum and plasma for every tests.

Test code	Integer	Its been used as the primary key
Test name	String	Its used to store the name of the tests
Serum level	float	The legal serum level are stored here
Plasma level	Float	The legal plasma level are stored here

- Table name :Detailed results table
- Purpose : To store and use the detailed biological results .

Test code	Integer	Its been used as the primary key
Test name	String	Its used to store the name of the tests
Test result	Float	The result of the tests are stored here
Serum level	Float	The level of the serum after the test are stored here
Plasma level	Float	The level of the plasma after the test are stored here

ENTITY RELATIOSHIP DIAGRAM

DATA FLOW DIAGRAMS

5.2 *Data Flow Diagrams*

Context diagram:

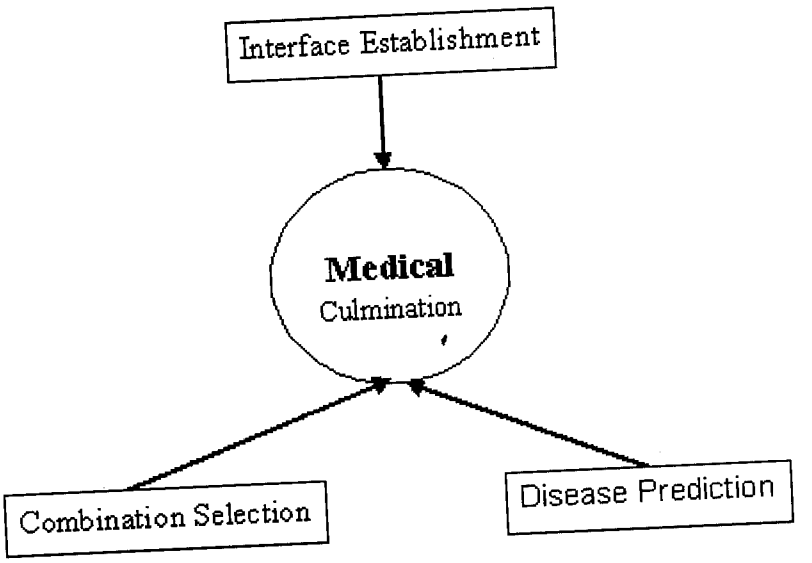


Figure: Context diagram for the whole System.

From the above diagram it is evident that there are three main modules for the medical culmination system , namely,

- *Interface Establishment*

- Used to establish a communication path between the electronic equipment and the computer machine

- *Combination Selection*

- Used to determine the groups among the biological tests available.

- *Disease Prediction*

- Used to diagnose the disease based on the evaluated test results

Level 1 – Interface Establishment:

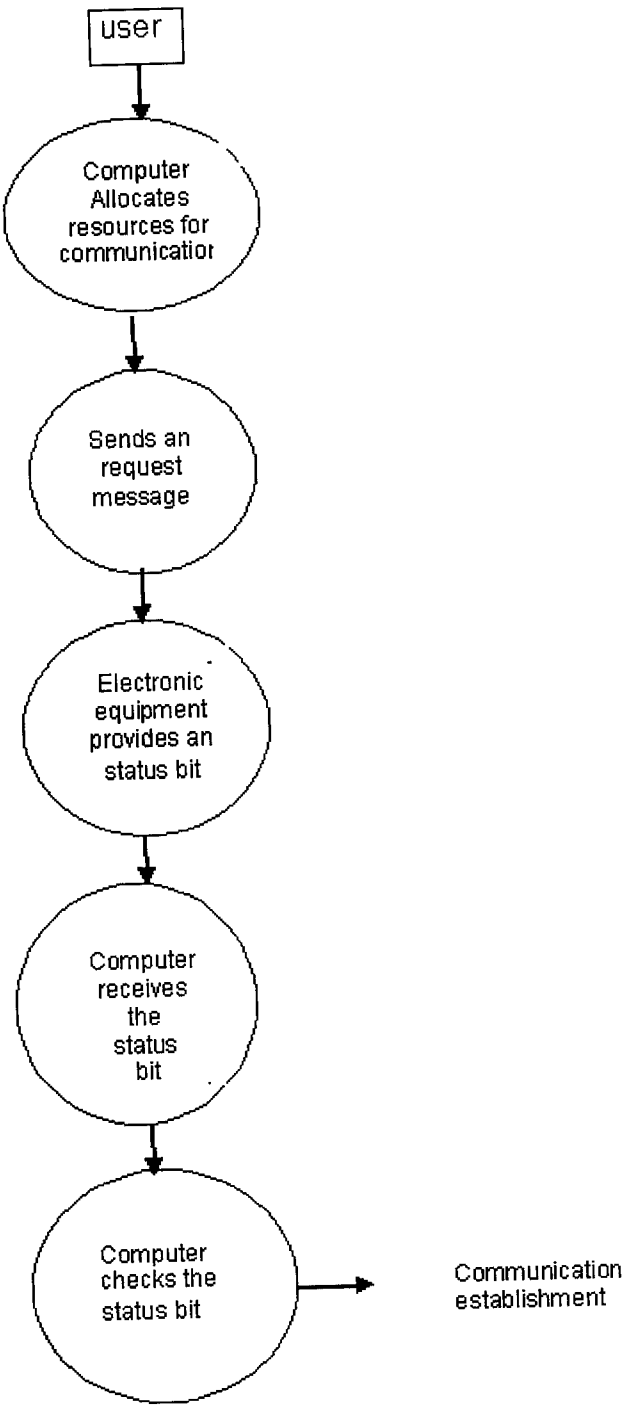


Figure: Level -1 diagram for the Interface Establishment module

Level 1 – Combination Selection :

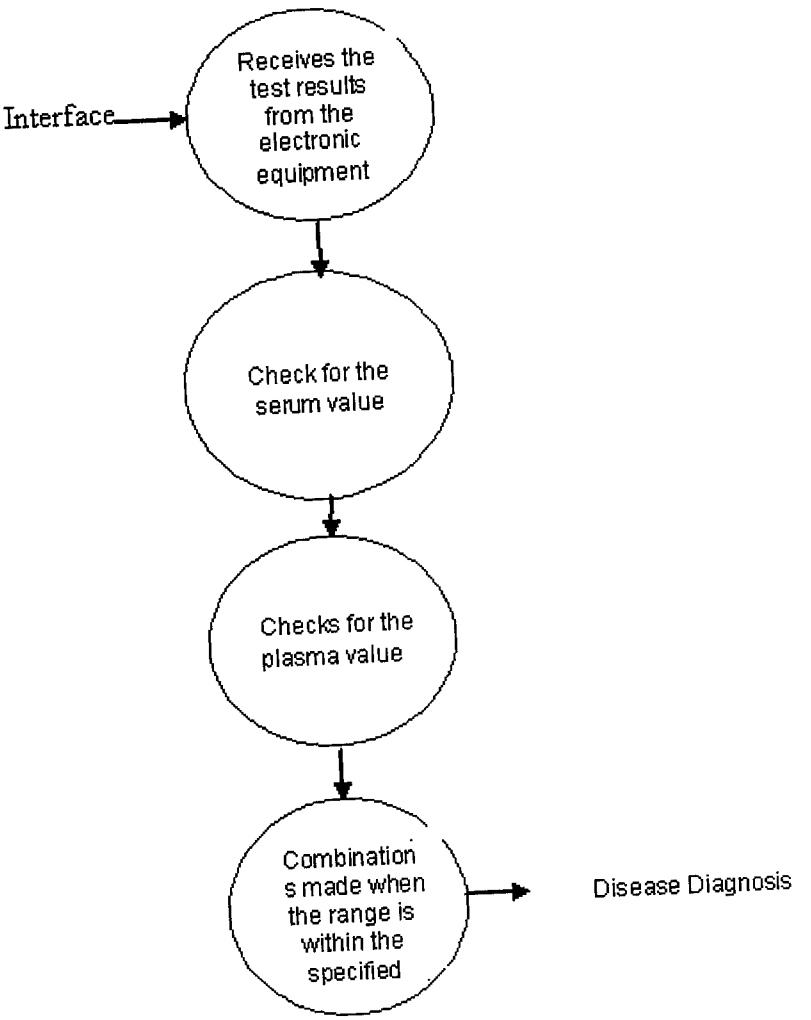


Figure: Level -1 diagram for the Combination Selection module

Level 1 – Disease Prediction:

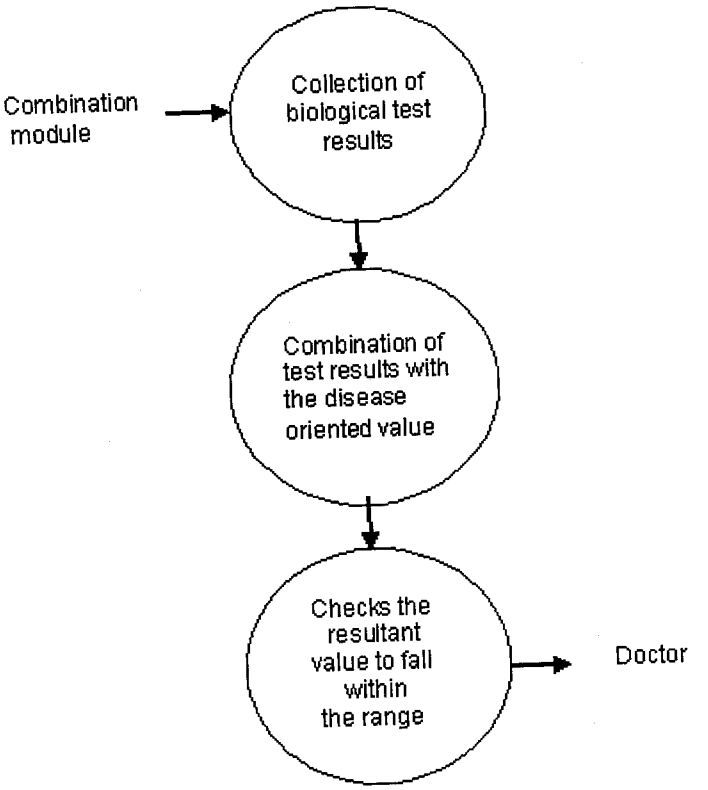
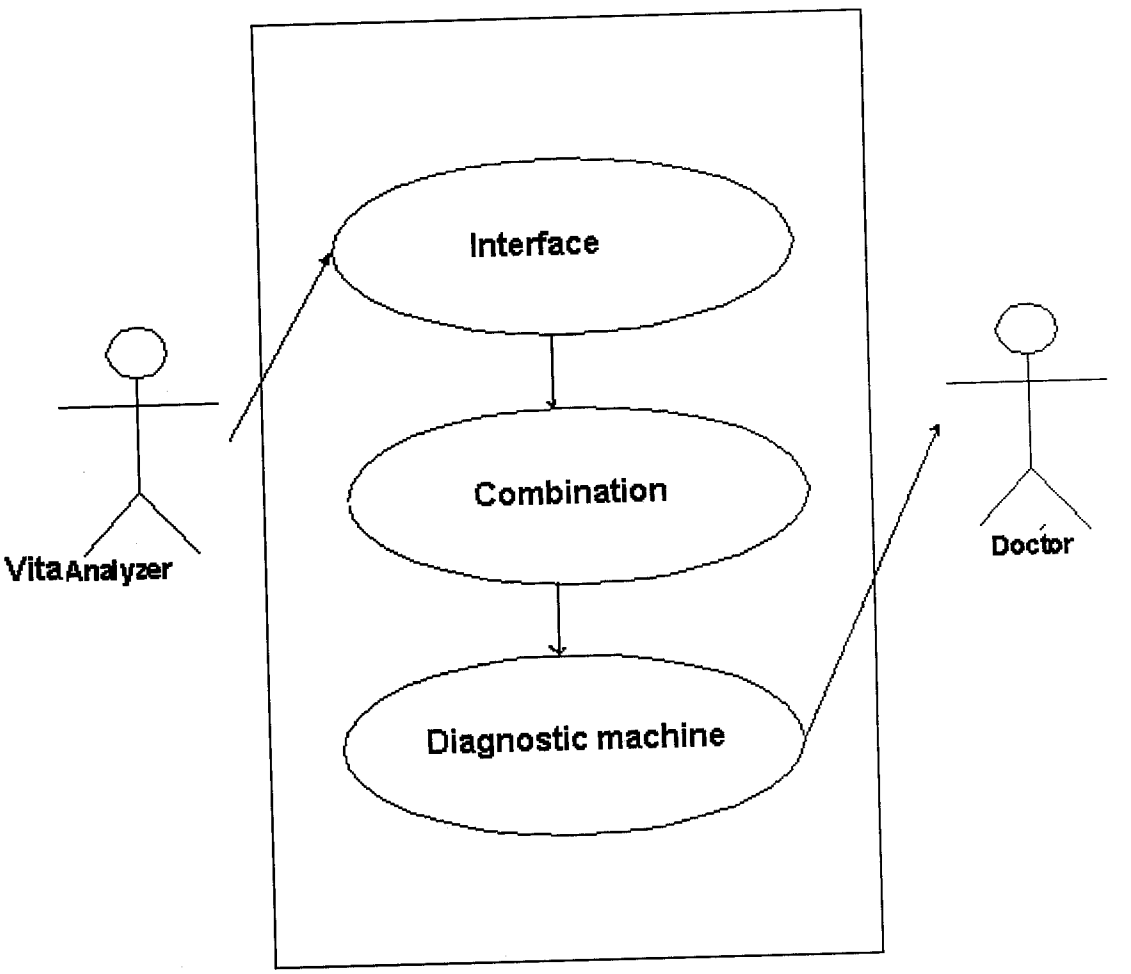
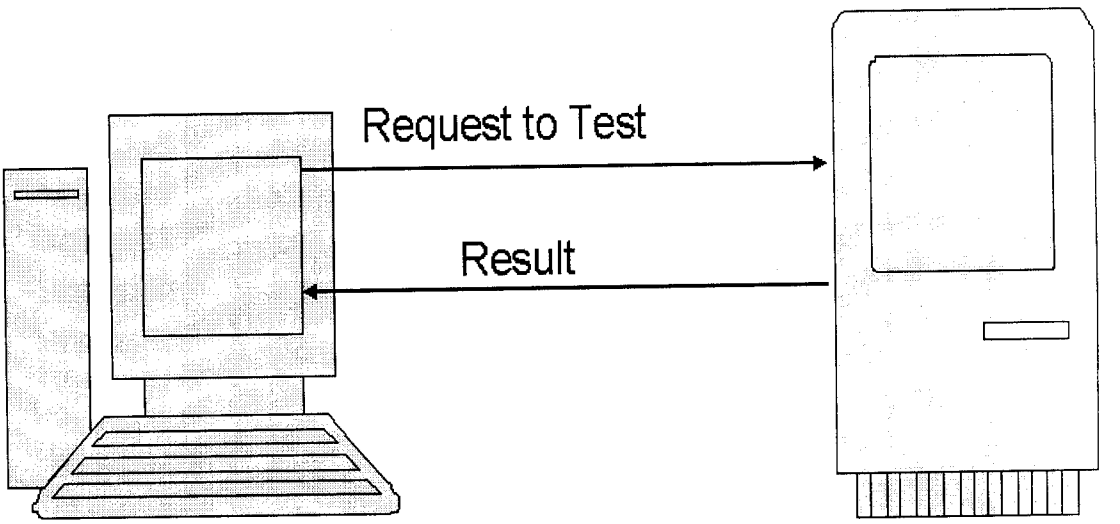


Figure: Level -1 diagram for the disease diagnosis module

5.3 *Use Case Diagram*



5.4 *Architecture*



Computer Machine

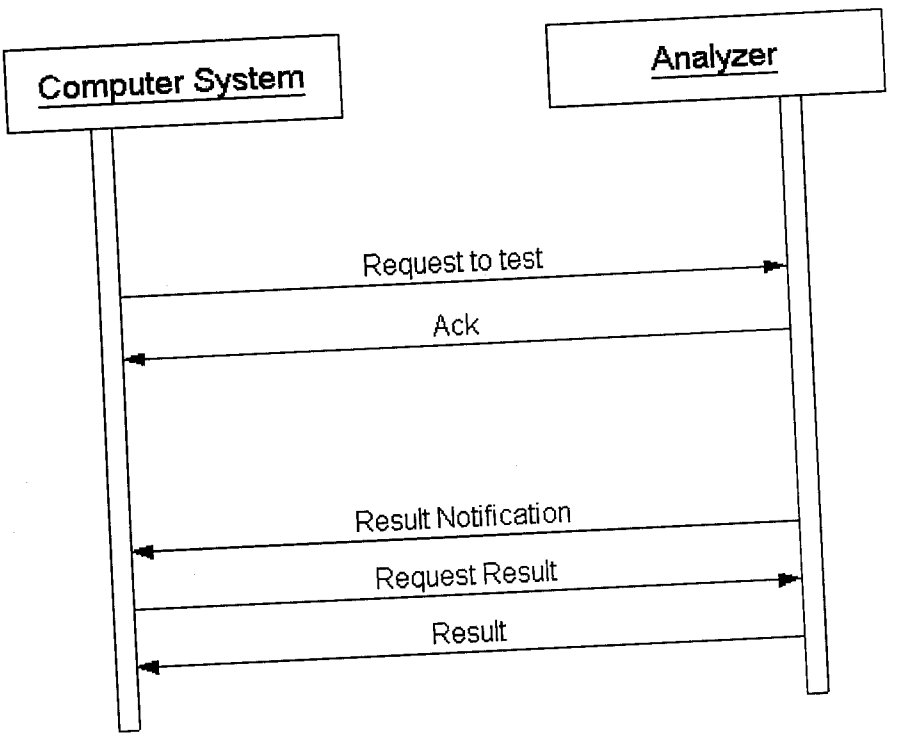
Combination & Diagnosis
Performed here

Electronic Equipment

Detailed Biological Tests
Performed here

5.5 *Sequence diagram*

This diagram represents the communication sequence between the electronic equipment and the computer machine.



TESTING

❖ *Bottom up integration*

This begins its construction and testing at atomic modules. Because modules are integrated from the bottom-up, processing required for modules subordinate to a given level is always available and the need for stubs is estimated. The following steps were used in the implementation of this testing strategy.

- ❖ Low-level modules are combined into clusters that perform a specific software sub functions.
- ❖ A driver is written to co-ordinate test case input and output.
- ❖ The cluster is tested.
- ❖ Drivers are removed and clusters are combined moving upward in the program structure.

PROJECT LEGACY

7.5 *Managerial Lessons Learned*

- The flow of the organization
- Interacting with the end-users
- Educating the end-users who are not aware of the modules
- How to move along with higher officials?
- How to be in a team and to be unique?

CONCLUSION & FUTURE ENHANCEMENTS

8.1 *Conclusion*

Automating the present manual process into an effective and efficient manner is done to the satisfaction of the end-user. The system has been built with the latest technology to make best of all resources. It is very user-friendly, simple and interactive system thus makes work easier.

8.2 *Future Enhancements*

The system has been developed flexible enough to support future enhancements. The system had been designed such that it accepts the modifications without affecting the presently developed systems functionally to a maximum extent.

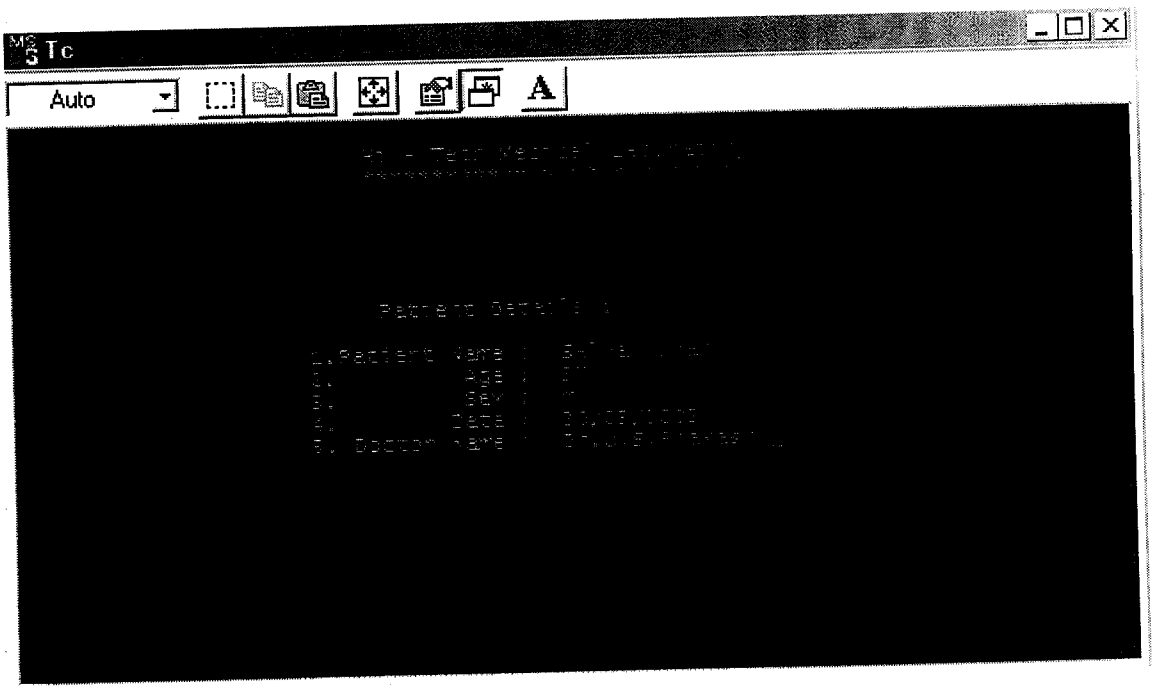
The some of the future enhancements are:

- Embedding "knowledge based search" using Aritificial Intellingence for urine analysement.
- Making up an network between all the computer machines,so that any computer can handle the electronic equipement .
- With the help of special processors , monitoring the activites performed by all the electronic equipmements in the laboratory.

8.3 *Sample Screens:*

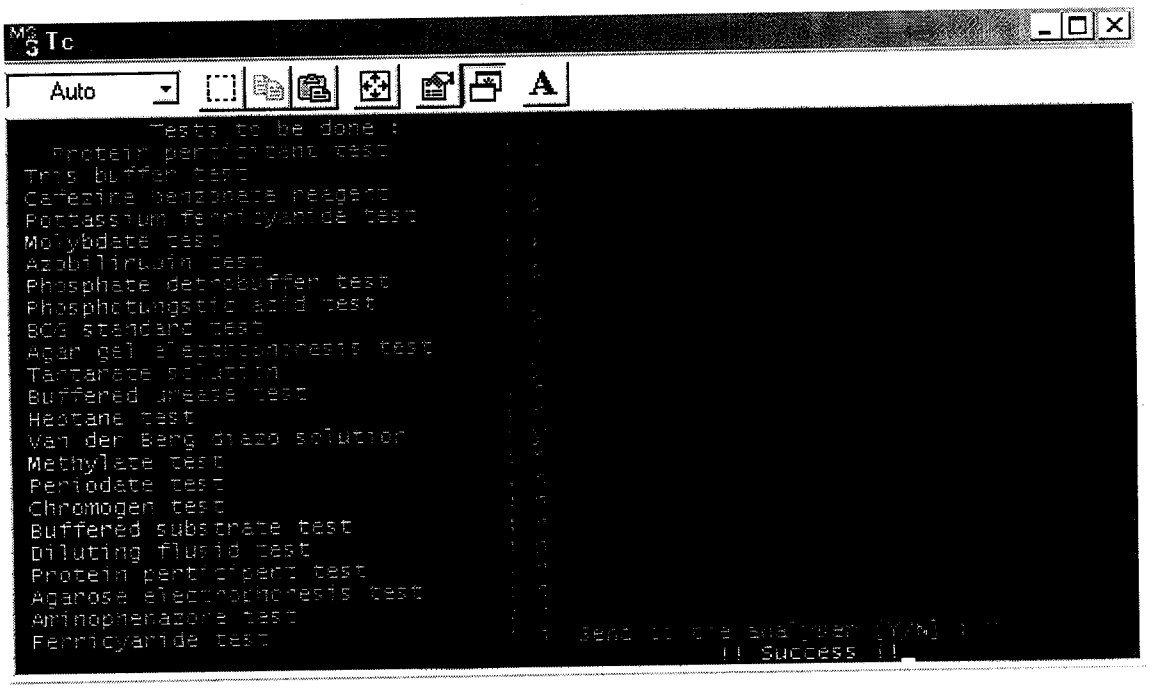
Screen 1 :

\- Getting the patient details -



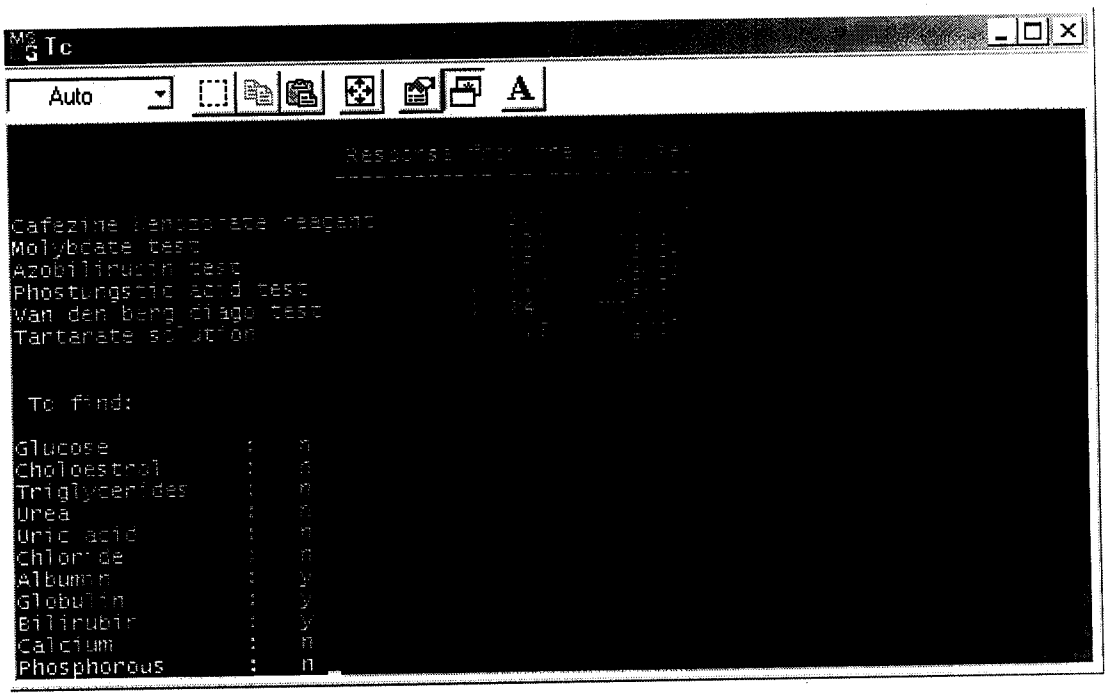
Screen 2:

- Getting the test names that are to be done in the electronic equipment and sending it to the electrnic equipment -



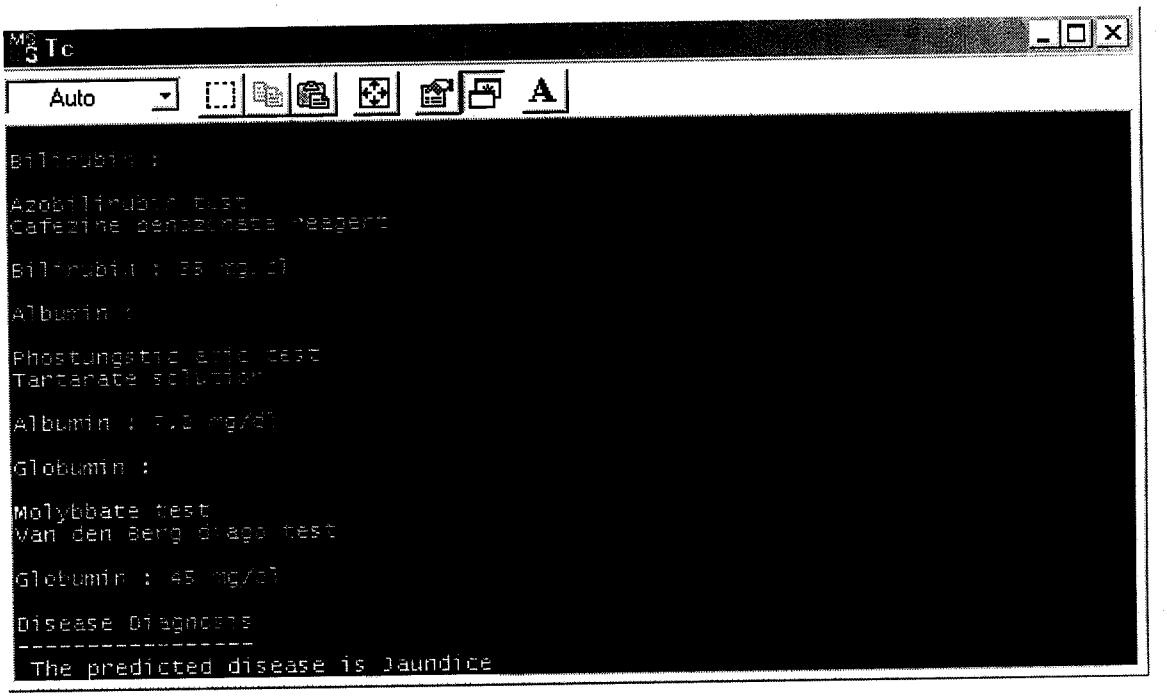
Screen 3:

- Getting the biological results that are to be evaluated and the results after the evaluation -



Screen 4:

- The disease diagnosed based on the evaluated results -



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