Implementation of Prototype for Detection and Management of Diabetes using Android Mobile Phone Application and Rule Base System

Ketan D. Bodhe, Ashish S. Sambare, Nikesh V. Aote, Parag Naik, Deepa Kale

Department of Computer Science & Engineering, Priyadarshini Institute of Engineering & Technology, Nagpur, INDIA

Abstract— In a research relating to identify and diagnose diseases, the pattern of disease is an important part. In that; these diseases can be identified by the various symptoms in human beings. These various symptoms identify the types of illnesses in human beings. This work is towards the identification of the diabetes. This implemented healthcare system mainly takes care of patients who suffer from chronic disease like diabetes. Such chronic patients can perform some simple self healthcare and monitoring functions via mobile phones through the implemented system to know about the circumstance of diabetes.

The work embodies the development of a prototype mobile healthcare system intended to take the various symptoms in the form of questionnaire from a patient. In this research, A mobile application is developed for android devices. For diagnosis of the diabetes symptoms, different rules are defined in expert system along with the score. Using this score, symptoms of diabetes are identified and result is provided to the user.

Keywords— Android OS, JSON, PHP, e-CLIPS

I. INTRODUCTION

Diabetes is a multifaceted disease and very widespread in the modern world. Diabetes is a serious disease that affects almost every organ in the body like heart, eyes, kidney, skin, nerves, blood vessels, foot etc. If the diabetes is not checked, it will make serious complications including death.[1]

There are several of systems are implemented for the diagnosis of the patients. For continuous monitoring of patient, an intelligent remote monitoring system is developed which help the doctors to keep eye on that implanted artificial heart [2]. In an alert management mechanism, using commercial mobile phones with Bluetooth communication capability attached to chronic patients. This system has implemented over the physiological signal recognition algorithms that could process the clinical data [3]. In decision support system for management of remotely monitored patient, An enterprise application-server framework, combined with a rules engine and statistical analysis tools, is used to analyze the acquired telehealth data, searching for trends and shifts in parameter values, as well as identifying individual measurements that exceed predetermined or adaptive thresholds [4].

Due to the rapidly increasing of the mobile devices attached to the Internet. A lot of researchers had been developed to manage and maximize the benefit of such integration. There is vital role of Artificial Intelligence concerning to Medicine filed from the very earliest moments in the modern history of computer. It is true that the medical field is a crucial and beneficial aspect of artificial intelligence.

In this paper, here it is implemented a mobile application that will connect to remote online self-diagnosis system for people to see their risk for having diabetes. Three tier architecture is used for describing the system overview. For the diagnosis of diabetes the major factor is measurement of glucose level. The different types of test for glucose level are specified in this paper. Rule base expert system is testing facts against the rules for the results. Forward chaining method is use in this expert system. For the detection of diabetes symptoms, score for each symptom is defined. These symptoms are categories in three parts: classical symptoms, primary symptoms and other symptoms. The developed system is considered as “Diabetes Aid” which is consists of “m-Health” mobile application and expert system. A mobile application, database server and knowledge base server are implemented for the prototype of diabetes detection. Since health diagnosis results expressed by verbal language often involve a mixture of uncertainties in the outcomes that are governed by the meaning of linguistic terms, inference under uncertainty is always a major issue.

II. SYSTEM OVERVIEW

This system consisting of a client side Android mobile application connecting to the remote server, server mainly responsible for running expert system program as well as
it also stores all the other information about patient like its food details, glucose level, BP, Medication and exercise information etc.[5]

In this system three tier architecture is considered for communication between client and server. At client side application, graphical user interface is created for android mobile devices; through which user can simply send the different parameters (diabetes related) of him to the server. At server side system design is an application that manages the patient information and evaluate this information with rule base system and forecast the probability of diabetes and provide judgment to user in the form of advice and ePrescription. For detection of diabetes questioner module asks questions to patient and sends this information to server where it tested against the decision support system (Rule based system) and ensuing output is again sending back to client.[5]

Measurement of Glucose Level

i) Fasting Plasma Glucose [6]: The fasting plasma glucose (FPG) test is the standard test for diabetes. It is a simple blood test taken after 8 hours of fasting.
   • FPG levels are considered normal up to 100 mg/dL.
   • Levels between 100 and 125 mg/dL are referred to as impaired fasting glucose or Pre-diabetes.
   • Diabetes is diagnosed when FPG levels are 126 mg/dL or higher on two or more tests on different days.

ii) Postprandial blood glucose test (PPB): Take good amount of food after FPG wait 2 hours, and do the blood test again. Postprandial glucose level should be under 140 mg/dL. The value between 140 and 199mg/dL show prediabetes.200 and above value may specify diabetes.[7]

iii) Random blood glucose test[7]: A blood glucose level of 200 mg/dl or higher indicates diabetes

iv) Measurement of heart rate: Normal resting heart rates range anywhere from 40 beats per minute up to 100 beats per minute [8]. Ideally the normal heart rate is between 60-90 beats per minute.

v) Measurement of blood pressure: The blood pressure is an necessary and normal part of the way the body works. High blood pressure can enlarge and weaken the heart. General expression for the blood pressure is two numbers, such as 120/80 mmHg.

Measurement of Body Mass Index (BMI): Body mass index is measure of body fat based on height and weight that applies to both adult men and women. The BMI categories are listed as : BMI≤18.5 underweight, 18.5≤BMI≤25 normal weight, 25≤BMI≤30 overweight 30≤BMI Obesity.

IV. RULE BASED EXPERT SYSTEMS

One of the most popular types of expert system today is the rule based or production rule system. A rule is conditional statement that links given conditions to actions or outcomes. Expert systems making use of rules to store knowledge are called rule based expert systems. It is based on an efficient algorithm called RETE pattern matching algorithm [9] for matching facts against the patterns in rules to determine which rules have had their conditions satisfied. Rule based expert system use human expert knowledge to solve real world problems that normally would require human intelligence. Expert’s knowledge is represented in the form of rules or as data within the computer. Depending upon the problem requirement these rules and data can be recalled to solve problems.[10]
engines used in rule based expert systems are forward chining and backward chaining system.

- **Forward chaining:** It starts with the facts and works forward to reach the conclusion. It involves checking the condition part of the rule to determine whether it is true or false. If the condition is true then the action part of the rule is also true. This procedure continues until the solution is found or a dead end is reached. Forward chaining is commonly referred to as data driven reasoning. [12]

- **Backward chaining:** It is the process of starting with the conclusion and working backward to the supporting facts. It is the reverse of forward chaining. Thus backward chaining is also called goal-driven reasoning.

V. DIABETES DETECTION

For detection of diabetes score Accumulation method is use to calculate severity of causing diabetes [5]. This module containing different questionnaire where each question having different score values that is given after the analysis of symptoms like primary symptoms, classic symptoms and others. Following Algorithm Flow Graph Fig. 3.1 to Fig.3.2 are drawn by considering forward chaining Technique to detect diabetes or what are the chances that causing diabetes to patient. Flow graph 3.3 and 3.4 specifying the probability of diabetes according to the symptoms and its related score.

VI. DIABETES AID

This paper involves the development of Diabetes Aid, an expert system to assist doctors in treating and managing diabetes patients. Diabetes Aid consists of a mobile application and Expert System that running at server side.

The first mobile application allow the user/patient to take diabetes test based on Questioner as well as it also allow to enter the various detail related to management of Diabetes. Server module allows doctors to quickly and easily to see information needed in the diagnosis of a patient. Server mainly implanted with help of PHP and MySQL database where database shared among the server and Knowledge base System (Expert System).

A mobile application Synchronies its local database with server whenever patient modify its details also whenever patient take test it prompt to synchronies with server. For transferring data from mobile to server it uses Light weight

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**Fig.3.2. Diabetes Detection Flow graph**

**Fig.3.3. Diabetes Detection Flow graph**
Fig.3.4. Diabetes Detection Flow graph

JSON object that reduces the transferring time also load on mobile client.

This architecture makes it easier for patient as they need only to carry one item with them throughout the day after uploading patient records for the patients they are to see that day. To aid ease of use, simple GUI has been implemented it’s more user-friendly that consisting of forms with editable textboxes and message boxes for questioner and easy Tab view. In addition to data management, Diabetes Aid can also formulate the suggestions of feasible treatments for the doctor. Diabetes Aid is intended to run on Android 2.3 on ward devices Expert medical information was assimilated from interviewing with Dr. Prafulla Sidam, Yavatmal (India) and the collecting the information from Various books as well as from American Diabetes Association’s guidelines for the treatment of diabetes Fig 4 showing the complete system architecture that illustrate the three module client, Database server and Knowledge base server.

The following algorithm shows how it working:

```java
// CLIENT MODULE
START
USER INPUT:
Get Details
Solve Questioner
Process:
if(SynchID==null)
{
 Synchronisation_with_server()
}

// DATABASE SERVER MODULE
Process:
Read JSON object;
if(SynchID==null)
{
 Encode Parameters;
 Update_Into_DataBase();
 Synchronisation_with_client();
 WriteChanges_to_client();
}

// KNOWLEDGEBASE SERVER MODULE
Declaration
float score;
String test_result, ePricecription;
Process:
while(1)
{
  // Running knowledge base server
  Run()
  {
    Read_Database();
    Read_table_test_quetion()
    {
      // evaluate with knowledge base program
      Evaluate_Test();
      return test_result;
    }
  }
  Write_ePriscription_DataBase();
}

STOP
```

VII. IMPLEMENTATION
The system is implemented by means of Android 2.3, PHP and Netbin 7.0. PHP is a server-side web programming language. The components are described as follows:
Mobile client Application: The user can access the system through a Mobile Application in Android OS interface, which has been implemented by using Android 2.3 and JSON is for transferring of data to the database server.

Database server: The database server mainly use for processing the JSON object and retrieve the complete information from client application and update with in database tables using PHP scripts whenever communication occurs.

Knowledge base server: The KBserver includes all the facts on which inferences are derived. The knowledge-base contains rules with which the inference engine draws conclusions. These conclusions are the system’s responses to the user’s queries passes from mobile application through database server. KBserver dynamically reading data from database server and according to data it produce results as well as it also shows the complete detail about the patient to doctor/expert so that he can provide suggestion or guideline for controlling diabetes.

The type of information stored in the database includes all of ‘Yes’ or ‘No’ answers. In the online mHealth server system, facts representing information are dynamically added to the fact list according to the user’s queries. Samples of facts used in this paper are listed in Table 1.

<table>
<thead>
<tr>
<th>Rule No</th>
<th>Rule Name</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age above 43</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>BMI is above level 30 (obesity)</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Smoking habit</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Excessive Thirsty</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Frequent urination</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Extreme hunger</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 5 showing the front end of m-Health mobile application by which user can login in to the system and take self test for diabetes detection.

VIII. ONLINE MHEALTH SERVER

The system has been evaluated by sample data. The main page of server is shown in Figure 6. The system provides two types of diagnosis. In first type, sever can provide the diagnostic result based on the self-test, which is based on answer of bipolar questions. In second type, doctor can...
also provide its expert suggestion to the patient for managing diabetes. Intentionally it put explicit result sending options in this module.

Fig.6. Front panel of Diagnosis System on server.

IX. CONCLUSION

New opportunities open up for developing mobile healthcare systems which accept the patient information on behalf of patient itself or in presence of doctor that can allow to transfer this data remotely to the expert system and make it easy to get rapid diagnosis from remote area. It also will improve the diagnosis and treatment of diabetes disease by allowing a more realistic view on the patients’ health condition. Sophisticated mobile healthcare systems will certainly arise in the near future. This paper presents a “Diabetes Aid”, a program intended to assist doctors in the treatment and tracking of patients with diabetes. The paper discusses the usefulness of such a system and examines other decision support systems in the medical field. The use of “Diabetes Aid” and some of the implementation details were presented. Finally, possible extensions to this program are discussed. The goal of this thesis is to implement and design a prototype mobile healthcare system consisting of three parts: a records data from a patient in real-time, an Android mobile phone which forwards the received data to a central server and finally a server responsible to store and analyze that data by expert system. It uses rule based approach to collect data and forward chaining inference technique.

In case of diagnosis the system will ask a bunch of questions about the symptoms and risk factors to the expert system user and user should give bipolar (yes or no) answer. And it uses a score accumulation method to decide the level of impact of diabetes in individual.

According to the reply the system will make decision about the risk of illness, how much severe it is like slight chance, moderate chance, high chance, very high chance, diabetic or not.

REFERENCES


[8] Jaesoon Choi, Member, IEEE, JunW. Park, Member, IEEE, Jinhan Chung, Student Member, IEEE, and Byoung G. Min, Member, IEEE ” An Intelligent Remote Diabetic Self-Diagnosis Monitoring System for Artificial Heart” IEEE transactions on information technology in biomedicine, vol. 9, no. 4, december 200.


