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Heart Disease Detection using Android Application and Internet of Things (IoT)

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Abstract: ***The number of deaths caused by heart attacks is about 25% of the total death in India. This occurs due to the delay in detecting the symptoms or lack of early diagnosis. This can be avoiding by integrating mobile computing technologies with health care systems. Which will lead the detection of abnormal heart rhythms and predict heart attacks before it occurs. Heart disease is a major cause of morbidity and mortality in the modern society.***

Keywords: pulse sensor; arduino board; smart phones;Internet of Things

1. Introduction

As per statistics of world health organization, 17.5 million people died from cardiovascular diseases in 2012 due to heart attacks. It's representing 31% global deaths in this year. Of these deaths, an estimated 7.4 million were due to coronary heart disease and 6.7 million were due to stroke. Out of 16 million deaths under the age of 70 due to non-communicable diseases, 82% are in low and middle income countries [1]. Early detection of heart disease systems are required to avoid heart diseases. This detection is required with the mobility and minimum cost so that it can be used anywhere and anytime. Moreover GSM based applications could be easily developed and enhanced due to easily accessibility of components in local markets [4].

Computer programs and hardware are very less error prone so it can be used for this major disease detection to avoid miscommunication. Expert identified lots of techniques to avoid these types of diseases, but many of the techniques are human intervention with the patient's existence. One of the techniques is Variable centered intelligence rule system (VCIRS). This expert system has an advantage in data repair system, if an error occurs or data development, data updates can be done without having to create a system from scratch [2].

Rule based system gives the knowledge of what, how, and why questions from rule base during inference. Problem with this technique is that it can't easily perform knowledge acquisition process and it can't update the rules automatically. Ripple down system (RDR) came up to overcome the major problem of expert systems. RDR allows for extremely rapid and simple knowledge acquisition without the help of a knowledge engineer. The limitation of RDR is the lack of powerful inference [2].

In this research we integrate the android application with pulse sensor and Arduino board. Pulse sensor microcontroller measures heart rate through fingertip or earlobes. Arduino board read the analog input (light on sensor) and converts it into digital output.

2. Reasearch Work

This research is focusing to develop the android application for analysis of heart disease. Start with making questionnaire symptoms that arise from a disease that would be basic knowledge for diagnosing heart disease. The questionnaire is prepared after communicating to the doctors and existing literature survey. Cardiologist suggested some diagnostic parameters and the accountability of the symptoms. Variable centered intelligence rule system used these suggestions as variables in this research. Variable centered intelligent rule systems methodology is used as a main method to further analysis of the disease.

A. Variable Chart Preparation

These variables are used to analysis of heart disease and finding out the intensity of the heart disease. There are 3 types of heart diseases, which is as following

1) Coronary heart disease
2) Hypertensive heart disease
3) Rheumatic heart disease

The information after discussing with the doctors can be considered as the first draft of a comprehensive set of the variables to considered as diagnostic indicators. We consulted to the cardiologist about this draft questionnaire, asking their suggestion about the probability of each symptom for each kind of heart disease according to the variables measures.

B. Variables Stipulation

This system considered 29 variables those taken from 29 symptoms of heart disease, which is based on the questionnaire provided to cardiologist, which is shown in table 1.Every heart disease had some conviction that would be used to maintain the sequence in variable.

Symptoms
Pain in the chest like a hot depressed, radiating to the left arm and then followed by a cold sweat
Obesity with characterized by abdominal circumference more than 80 cm for women and 90 cm for men and BMI(Body Mass Index) greater than 25
Having a low HDL, high LDL and high triglycerides
heavy smokers(more than 20 cigarettes/day)
have a history of diabetes mellitus
has a history of cholesterol
Always consumption of fatty foods
Rarely do sport
have blood pressure over 140/70 mm Hg and in long time
Swelling (edema) in the legs or abdomen
Feel palpitations (pounding), accompanied by a cold sweat
Feeling dizzy
Feel fatigue when on the move, and stiffness in the head and neck
Experiencing blurred vision suddenly that cannot be overcome by the use of glasses, this issue is caused by bleeding in the retina
Experiencing shortness of breath while walking less than 100 meters
Experience shortness of breath when lying down and has to use of body buffer(pillow) to eliminate the shortness of breath
Unstable emotional
Fever with pharyngitis and streptococcal
Heart rate greater than 100 (tachycardia) but not febrile
Dilation of veins in the neck of patients that can be felt when palpated when the patient is lying with buffer (a pillow)
Erythema marginatum occurs that last for weeks or even months, no pain and no itch
Experienced polyarthritis and increased 12-24 hours followed inflammatory reaction
Got chorea more than 2-6 months
There are subcutaneous nodules with a width of about 0.5-2 cm round and painless when in the press
Pulse deficit
Often experienced the symptoms of pain in the heart about 4:00 am to 10:00 am
More than 50 years old and a man
A women and has entered into the postmenopausal stage
Aged less than 15 years

C. Overview and system diagram

When the user activates the heart disease detection application, then it will be activating pulse sensor that detects heart rate of user by placing finger or keeping sensor on earlobe and it transmit result to arduino ADK in the form of analog signal. Arduino ADK converts analog heart rate signal into digital signal and sends the data to android phone. After this process, system asks user to insert the clinical symptoms that they felt. After inputting the symptoms the diagnosed of coronary or hypertension or rheumatic heart disease or do not get any kind of heart disease are showed. The result followed by analysis of the value of usage variable rate, node usage rate, and rule usage rate that shows the value of the rule that will increase when symptoms frequently used. At the other hand, the result of the heart disease on the phone screen will be easy to understand. Below figure 1 show the system diagram.

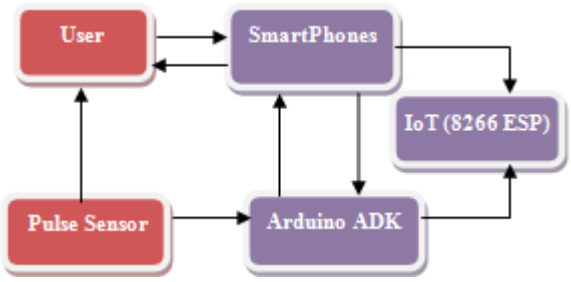

Figure 1: Block diagram of system

Android application contains three menus, such as BMI menu, glossary menu and tip menu. BMI menu is used to detect user body mass index. Glossary menu contain some difficult words in the form of symptoms and tip menu used to provide tips to avoid or prevent heart disease.

Smart phone send data to IoT on Wifi or it can send data on internet. Currently I focused on Wifi to send the data to other devices. But we can use IoT to send the data on internet. Heart disease data is more sensitive because it contains health threatening. So, if we send this data as early as possible to doctor or relatives then, patient can get early treatment and it will save patients life.

3. Result and Discusion

User select the checkbox of each question according to the symptoms which user felt. Then system compares the selection with the expert rules and gives the result. If we expressed draft rule in the form of if –then as below:

```
if
   have blood presser over 140/70 mm Hg and in long time
   yes
if
   Swelling in the legs or abdomen
   yes
if
   Feel palpitations, accompanied by a cold sweat
   yes
if
   Feeling dizzy
   yes
if
   Feel fatigue when on the move, and stiffness in the head and
   neck
   yes
if
   Experiencing blurred vision suddenly that cannot be
   overcome by the use of glasses, the issue is caused by
   bleeding in the retina
   Yes
if
   Experiencing shortness of breath while walking less than 100
   meters
   yes
if
   Experiencing shortness of breath when lying down and had to
   use a body buffer to eliminate the shortness of breath
   Yes
if
   Dilatation of veins in the neck of patients that can be felt
   when palpated when lying with buffer
   Yes
if
```

More than 50 years old a man
Yes
then
Hypertension Heart Disease

if
Heart rate greater than 100 but not febrile
Yes
if
Experienced polyarthritis and increased 12-24 hours followed inflammatory reaction
Yes
if
There are subcutaneous nodules with a width of about 0.5-2 cm round and painless when in the press
Yes
if
Age less than 15 years
Yes
then
Rheumatic Heart Disease.

Same kind of expert rule gets applied for Coronary heart disease.

4. Conclusion

The system results and analysis that has been done in this research and it can be concluded that manual checking and system results are same. The value analysis shows the amount of value of each node and the rule variable that will continue to grow if selected by the user. These values does not affect to diagnosis detection and analysis. The expert system is designed and able to provide the same results with the results of the doctor's diagnosis. Internet of Things (IoT) is used to send the Heart disease details to other person by using the Wifi network.

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