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Doctor Semi-Automatic Assisstance System for Heart Diseases Detection

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ABSTRACT

This research is mainly concerned with enabling new heart specialist doctors to detect patients' heart diseases in a semi-automatic manner. The system we built is a web application system that also enables the share of health knowledge between the doctors and patients. Assisting the doctors in detecting heart diseases by enhancing and implementing a specified algorithm is an essential part in heart diseases detection knowledge because the system provides practical knowledge in a semi-automated mechanism for heart specialist doctors especially fresh specialized ones. Unfortunately, many mistakes happen during the detection of heart diseases. An approach to circumvent the errors in heart detection diseases is by employing a specific algorithm within a web application system in a user friendly way that assist the intended doctors in developing their practical skills and minimize any detection errors. Our research is aimed at checking and proofing the appropriateness of auto-detection of heart diseases to be used in applying client doctor-interfaces in heart diseases detection. In addition doctors can carry out a practical training by exercising many heart diseases cases using our system.

Keywords: *software engineering, algorithm, user friendly*.

1. INTRODUCTION

Nowadays, new doctors specialist in heart diseases suffer the reduction of learning opportunities and training for disease diagnosis, where there are needs for practicing besides theoretical courses exploiting the information and communication technology revolution. In order to give new graduated doctors better understanding of the instructed heart diseases diagnosis we developed a web application system to tackle these needs. Most works of these doctors will be in practical fields, which demands from them more time and efforts in reviewing theoretical aspects and relating them to practical cases they face. After graduation, they will not only depend on their theories acquired during their study at the university, but also on their practical knowledge they acquired by practicing the practical cases demonstrated by our system. Unfortunately, the doctors cannot remember all theoretical heart diagnosis theories and faced practical cases acquired during his study, so they need a system that automatically help them in detecting heart diseases and here comes the idea of our system .

This system aims to facilitate the work of doctors for better diagnosing of heart diseases in addition to other services such as archiving and accumulation of medical data for its close and significance association with the treatment process, psychological and medical support, better management for the diagnosing and treatment life cycle, and create awareness about the symptoms, causes and prevention of cardiac disease. The system will provide all these services on user-friendly way for patient, potential patient, medical and health entities, and especially under graduated and new graduated heart diseases specialist doctors.

The Heart Health system aims to improve the heart health care in all aspects, including prevention, through spreading awareness, diagnosing management, and therapy management, it also aims to create a social community for patient to share hope and experience, it also let physicians share experience, and consultations, through the system patients can ask the experts, and one or many physicians can answer and discuss the case giving an effective answer.

The ECG subsystem aims to provide a guide lines to help physicians reach the right diagnosis result. The patient or even the ideal guest and users have a large informative part to get fair knowledge about the heart health assessment tools, and improvement plans, the informative part which target different ages and educational level is implemented in a friendly way , and classified according to the famous Framingham Heart Study[1],which stipulates that the seven major risk factors in coronary heart disease are: elevated blood levels of cholesterol, elevated blood pressure, elevated blood uric acid levels ,certain metabolic disorders, notably diabetes, obesity, smoking, and lack of physical exercise.

Doctors have affair knowledge of pharmacology; but their knowledge of therapeutic is weak[2], they also manually interpret the ECG signals, which make it very possible to have some mistakes, especially with those who might not have the fair interpretation knowledge.

The application in the system must be accurate, this is the most critical point in this system, even though many other issues must be taken into consideration, the system must be supported run on existing hardware and software. And need the minimal technical support must be friendly for the user, secure from unauthorized users.

2. SYSTEM METHODOLOGY DEVELOPMENT

This project was built using the iterative development model; we start it with simple requirement,

new features were added in advanced, we chose this model because it seems to fit the poor knowledge in the medical area, we start our project with more knowledge, we've got better and better vision of what this system may offer as shown in figure 1.

In the collection of information, it was necessary to reference an accurate trusted resources, so we were very careful in this, we refer to the trusted internet resources referenced in the list such as the American heart association; we used some hand books rather than internet resources to get a better quality of information in the doctor packages, and along the development process we kept in touch with doctors but this time on the web, EKG club on the Facebook offers us the ability to get some answers when we were unsure about doctors preferences.[3]

3. DEVELOPING ECG ANALYZER USING DSML

ECG analyzer where built based on the analysis instruction of Prof. Dr. Aswini Kumar , in his presentation 'Electrocardiography for Students'[4].We used the domain specific modeling language (DSML) to adjust and redevelop the algorithm to analyze and diagnose heart diseases as illustrated in figure 3 in appendix.

The project introduce a broad solution for the widespread cardiac disease, through providing a package of services for every stakeholder, doctors package includes ECG analyzer, drug explorer, and drug therapy manager, they also can share experience in the 'Ask the doctor' board. Registered users package includes a set of friendly assessment tools for their health, plans to improve, advanced search for doctor with up to 10 optional parameter, archive the home tests such as weight and blood pressure, share success stories, share hope through the discussion board, 'Ask the doctors', pass private messages for other users, the user can also add his entity (that he own) to the website, then he will have the full entity package. Entity package includes adding employee to the entity, each employee can add promotion, archive the patient medical files and blood tests which are done inside the entity, and register nonregistered patient in less than 2 minutes. Finally the admin package include all the administrative tools upon all stakeholders, while the content of the website is also administrated by the websites employee, by providing them the ability to edit the whole informative part , as well as the content of the boards. Encourage social learning.

4. SYSTEM DESIGN

The main purpose of Heart Detection System is to prepare heart disease specialist doctors who can deal with related patients. Since heart disease detection is an applied science, its implementation contains the biggest part of practical studies. Therefore, developing a practical disease detection system is essential in medical education and implementation.

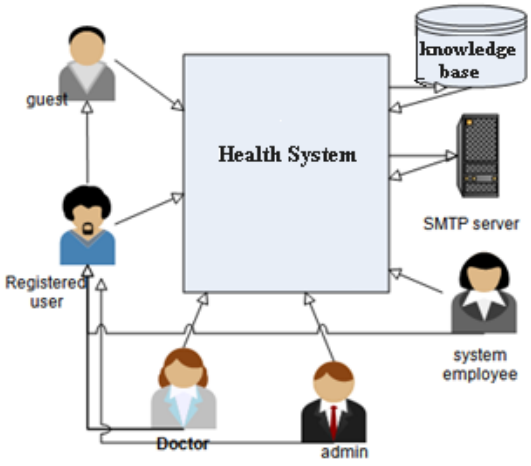

Fig 1: Generic Context Diagram

Nowadays, through aWeb browsers such as Microsoft Internet Explorer, Mozilla Firefox, Chrome etc.a suitable mean for data exchange between the patientand the doctorwas provided. After activating the URL address of the Webpage of the heart detectin system by the doctor, the Web browser loads the start Webpage of the heart data input, which embraces an authentication page for entering the system through a correct user name and password[5]. Ergonomic aspects are necessary for allowing effective human-computer interaction. The doctor-interface plays a central role for obtaining a harmonic interaction with the heart data setup with various usability aspecst to enhance the intercation with user-interafce

The systemusesan ECG image that is uploaded by the patient or medical entity. Therefore, a high quality Webcam is necessary to send ECG image to give realistic feedback for the doctors.

After the system process the image according to the comparison between the already stored images about different heart diseases in the system and the captured image , the algorithm will determine the type of the heart disease (see figure 2 in the Appendix).

5. IMPLEMENTATION

The system components have been incrementally built within an iterative system and software engineering process. In the iterative process, the stages: specification, design, development, but rather interleaved and concurrent This section discusses some important system used to detect heart disease.

The application in the proposed system must be accurate, this is the most critical point in this system, even though many other issues must be taken into consideration ,the system must be supported run on existing hardware and software. And need the minimal

technical support must be friendly for the user and secure from unauthorized users

For doctors, entity and patients have two options:

1. Do nothing: the work is doing well manually, and doctors can continue their work without this project, patient will keep on with the physical contact with their doctors, entity will keep up with their work flow.
2. Use this system, and make use of the facilities it offers.

The main features of this project are:

The entity can add employee, patient, promotion and patient record; it can also edit the blood tests archive. The doctor can use the drug therapy manager, drug usage, dosage and adverse explorer, ECG analyst, add his/her own operation history, add/edit his own working hours, add promotion and add/edit his own education information (degree …). The guest shall be able to contact us, let us call him/her and review the FAQs. The patient shall be able to search for a doctor (advanced search),post, comment and like at the discussion board, read, assess and take action, add any home tests record such as blood pressure, weight…, add their own success stories, read others success stories, send / receive private messages and view/edit his own medical profile.

The system provides people information about their heart health in friendly, easy to understand way, along with assessment tools and plans to improve. and connect patient themselves in a social network, by sharing success stories, passing private messages, and sharing public status and posts at the discussion board .In fact this is a very important issue, a study titled "Diabetes and depression: the roles of social support and medical symptoms" mentioned that" social support and physical health have been linked to each other and to depression"[6] , the study mentioned also that "findings underscore the potential importance of interpersonal factors in the physical health of individual with diabetes"[7]. Also the system connects doctors themselves, to exchange viewpoints and share experience. And connects physicians with patient, this purpose is achieved through the following services:

- Having central archive of the whole medical information for each patient, accessed by all the doctors.
- Drug dosage ,usage, and adverse explorer which enable physicians to choose the medications wisely so as to relieve patients suffering with a minimum of adverse effects and without restoring to polypharmacy.
- Drug therapy management service: this service helps in the management of the drug therapy of 9 wide spread cardiac disease, its lead by scientific systematic steps, it provides the typical solution even in the most confused area of the cardiac management, the procedure used here is driven by the book "cardiac drug therapy " referenced in the reference list, the procedure is derived from a thorough review of the word literature in drug management of cardiac conditions.

The importance of this service stems from the factor that "twenty years of teaching medical and post graduate students", professor Gabriel said, "fostered the realization that while they had affair knowledge of pharmacology; their knowledge of therapeutic was weak"[9].

6. CONCLUSION

This contribution discusses how we can build augmented reality remote system for doctors and patients.

Findings underscore the importance of developing web-based systems for the medical sector in general and for more specific medical sectors as well. The medical sector needs special requirement such as high level of accuracy, security, and reliability, which lead to a serious challenge to provide the best effort to keep such requirements. We recommend all patient, entities, and doctors to use this system, and take use of the services it offers.

Finally, we recommend developers to develop specialize web based medical solutions that can be merged and integrated with our and others systems.

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[6] Cardiac Drug Therapy ,M.I. Gabriel Khan, page ix.

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APPENDIX:

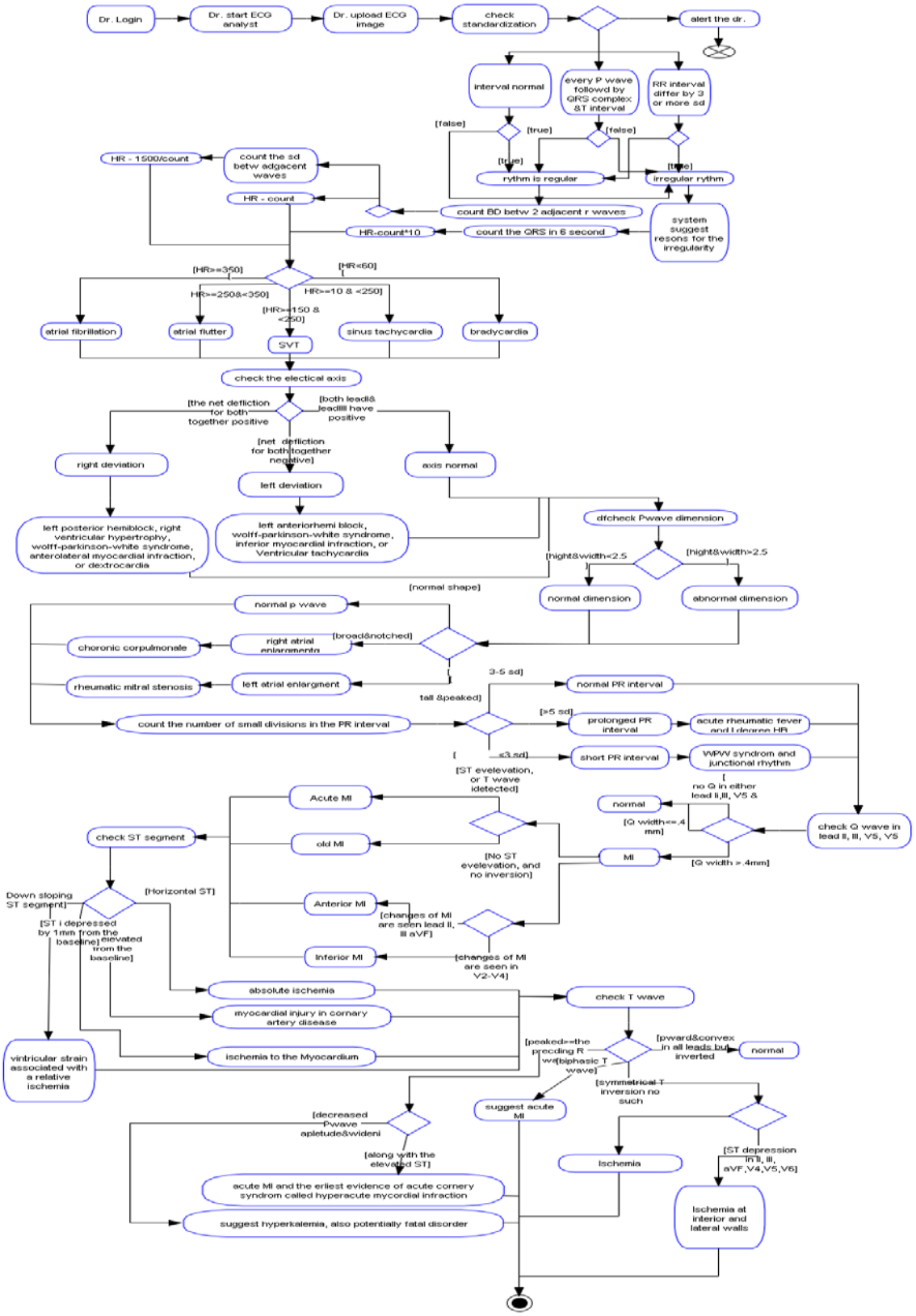

Fig 2: ECG Activity Diagram

```
Begin
Start ECG analysis;
Upload ECG image;
Check standardization;
If(half standardization)
        Alert the doctor;
Else
If(interval normal OR every P wave followed by QRS complex and T interval OR
        RR interval differ by 3 or more SD)
{Rhythm is regular;
        Count BD between two adjacent R waves;
        HR= count;
        Count the SD between two adjacent waves;
        HR=1500/count;}
Else
{       Irregular rhythm;
        System suggests reasons for the irregularity;
        Count the QRS in 6 seconds;
        HR=count*10;}
If(HR>=350)
        Atrial fibrillation;
Else
If(HR>=250 and HR<350)
        Atrial flutter;
Else
If (HR>=150 and HR<250)
        SVT;
Else
If (HR>=100 and HR<250)
        Sinus tachycardia;
Else
If (HR<=60)
        Bradycardia;
Check the electical axis;
If (the net deflection for both together is positive)
{       Right deviation;
        Left posterior hemiblock, right ventricular hypertrophy,
        Wolff-parkinson-white syndrome, anterolateral myocardial
        Infarction, or dextrocardia;}
If (the net deflection for both together is negative)
{       Left deviation;
        Left anterior hemiblock, Wolff-parkinson-white syndrome, inferior myocardial Infarction, or ventricular
        tachycardia;}
If(both leadI and leadIII have a positive Net deflection)
        Axis Normal;
If(Pwave dimension hight and width <2.5)
        Normal Dimension;
Else
If(Pwave dimension hight and width >2.5)
        Abnormal Dimension;
If(normal shape)
        Normal P wave;
Else
If(broad and notched)
{       Right atrial enlargement;
        Choroniccorpulmonale;}
Else
If(tall and peaked)
{       Right atrial enlargement;
        Rheumatic Mitral Stenosis;}
```

```
Count the number of small divisions in the PR interval;
If(count>=3 and count<=5 sd)
        Normal PR interval;
Else
If(count>5 sd)
{       Prolonged PR interval;
        Acute Rheumatic Fever and I degree HB;}
Else
If(count<3 sd)
{       Short PR interval;
        WPW Syndrome and Junctional Rhythm;}
Check Q wave in lead II,III,v5,v6;
If(no Q in either lead II, III, v5 and v6)
        Normal;
Else
If(Q width<=0.4mm)
        Normal;
Else
If(Q width>0.4mm)
{       MI;
        If(ST evelevation or T wave inversion is detected)
                Acute MI;
        Else
        If(No ST evelevation no inversion)
                Old MI;
        If(changes of MI are seen lead II, III and a VF)
                Anterior MI;
        Else
        If(changes of MI are seen in V2 – V4)
                Inferior MI;}
Check ST segment;
If(Down sloping ST segment)
        Ventricular strain associated with a relative Ischemia;
Else
If(Horizontal ST)
        Absolute ischemia;
Else
If(ST elevated from the baseline)
        Myocardial injury in coronary artery disease;
Else
If(ST is depressed by 1mm from the baseline)
        Ischemia to the Myocardium;
Check T wave;
If(peaked>=the preceding R wave)
{       If(along with the elevated ST)
                Acute MI, and the earliest evidence of acute cornery
                Syndrome called hyperacute myocardial infraction;
        Else
        If(along with decreased P wave apletude, and widening of QRS complex)
                Suggest hyperkalemia, also potentially fatal disorder;}
Else
If(Biphasic T wave)
        Suggest acute MI;
Else
If(upward and convex in all leads but inverted in a VR and V1)
        Normal;
Else
If(symmetric T inversion)
{       If(no such depression)
                Ischemia;
        Else
```

```
    If(with ST depression in II, III, aVF, V4,V5,V6)
            Ischemia at interior and lateral walls;}
End;
```

Fig 3: System Algorithm.