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Android Electrocardiogram for Classifying Ventricular Arrhythmia (VA-Classifier)

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Abstract

Ventricular Arrhythmia-classifier application (VA-classifier) is developed to provide a mobile android platform for diagnosing and managing activities of arrhythmias heart diseases. By changing the manual way of heart disease check-up in hospital to mobile system, the effectiveness and efficiency of diagnosis process will be improved, for instances this system can bring convenience and quicken the process of getting to know the conditions of patients who are suspected to have ventricular arrhythmia. By having a classifying mobile, there are no more problems of time and distance. Besides that, agile methodology is used in which the project is divided into several sprints for easy and fast delivery for a better outcome. Furthermore, three-tier architecture design is also used for the development of this project. Data dictionary and ERD is produced for a better understanding on system database. Several user interfaces are created to visualize the actual system environment. In addition, Java, PHP and MySQL is chosen during system development. As a conclusion, VA-classifier system facilitates the check-up method in hospitals with mobile application bringing benefits of convenience to the community.

Keywords: Ventricular Arrhythmia classifier, Mobile Android Platform, diagnosing and managing arrhythmia, time and distance

1.0 Introduction

Ventricular Arrhythmias classifier (VA-classifier) is a useful real time heart disease classifying android application. This system is mainly developed for the purpose of diagnosing and management of arrhythmias heart diseases. The aim is to have a system, which enables arrhythmias classification service; it can also be used as preventive care for adults. The proposed system is an alternative for the holter monitors, which have a function to monitor and measure a heart rate using battery-operated portable device.

Most of the systems only focused on recording or detecting arrhythmias. However, this system is designed to manage user's recordings between patients and doctors. To

overcome the weakness of the current holter monitors available in the market, this application proposed to be worked with a smartphone. An external hardware or device is added in order to detect and capture samples of signal frequency. This makes it possible to move heart monitoring away from the hospitals and clinics to portable personal devices.

Similar to the holters, the proposed tool will be easy and portable to carry anywhere. However, it will be more advanced due to its capability of visualizing and classifying sudden cardiac arrest in real time. A real time personal heart monitor can provide continuous information on the user's heart activity at all times and in any place.

The objectives of the projects are to study and evaluate an algorithm for classifying ventricular arrhythmia in the application, to design and develop mobile application for classifying ventricular arrhythmia using electrocardiogram and to test the applicable and adoptability of developed mobile application.

2.0 Problem Statement

Sudden Cardiac Arrest (SCA) is always caused by Ventricular Arrhythmias (VAs). It could lead to death in minutes for a patient with severe heart disease if emergency medical assistance is not provided(Chin *et al.*, 2011). Electro Cardio Graph (ECG) has been widely adopted to diagnose and evaluate the existence of VAs. The equipment mounted on a patient's body can sense an electrical activity of the heart. In many cases, a standard ECG owned by a hospital might be unable to detect the VAs because the patient was not experiencing SCA at that time(Weng *et al.*, 2013).

Several holter-based portable devices in the market, such as GE's SEER, Philips's DigiTrack and Midmark's IQmark, might lack effectiveness in giving a real time feedback to the arrhythmia event they recorded(Oresko *et al.*, 2010). In addition, the holters still need the cardiologist to perform an in depth offline analysis of the data recorded(Weng *et al*., 2013). This is problematic when the availability of hospital and medical experts is low. On the other hand, for real-time recording and diagnosis application in hospitals, the signal processing operations may be highly time-consuming for those people who are too busy to travel to the hospital personally.

Besides that, portable ECG products are not common in the medical market due to their high costs(Weng *et al*., 2013). So, if the terminal device could be replaced by consumer electronics that can be performed by everyone, the cost can surely be reduced. The mobile devices (smart-phone) should be capable of handling real-time classification of cardiac arrhythmia using ECG. It is important to devise a real-time mobile ECG signal analysis light algorithm for the detection of arrhythmias disease. Therefore, there is a need for an automatic, low-cost physiological monitoring solution that is easy to use, accurate and can be used at home or in ambulatory settings.

In this advanced world of technology, many new ideas that are very helpful in lightening the burden of people, especially to those who are busy, are continuously emerging. An understanding of customers' needs and factors influencing their behaviors and intentions

especially mobile heart monitoring and arrhythmia classification is a valuable tool in creating healthy society.

3.0 Methodology

The methodology that is used to develop VA-Classifier application is Agile. The justification of the methodology being chosen is that the Agile encourages rapid and iterative development of products in small releases. It focuses on improvement during and after product development. So, the development process can be more in control of the project schedule and state. Agile methods can response to a drastic degree of change and cope better with the changes of expected and unexpected requirements based on the current situation and environment. In conclusion, agile development methodology is a flexible, speedy, lean, learning and responsive methodology.

4.0 Result

Table 1 below shows the comparison of the proposed system, VA-Classifier and the existing system.

Table 1: Comparison of Proposed System and Existing system

	AliveECG	**AirStrip – Cardiology**	**iBP Monitor**	**Proposed System**
Disease Classification	Atrial Fibrillation	Chronic obstructive pulmonary disease (COPD), diabetes, congestive heart failure, or other chronic diseases.	Blood Pressure	Ventricular Arrhythmia
User	Patient	Cardiologist	Patient	Cardiologist /doctor and patient
ECG Graph	Yes	Yes	Yes	Yes
Classification	Yes	Yes	Yes	Yes
History Record	Yes	Yes	Yes	Yes
Share Result	Yes	Yes	No	Yes

View and give advice	No	No	No	Yes
View Disease Information or Knowledge	No	No	No	Yes

Figure 1 below shows some interfaces of VA-Classifier application.

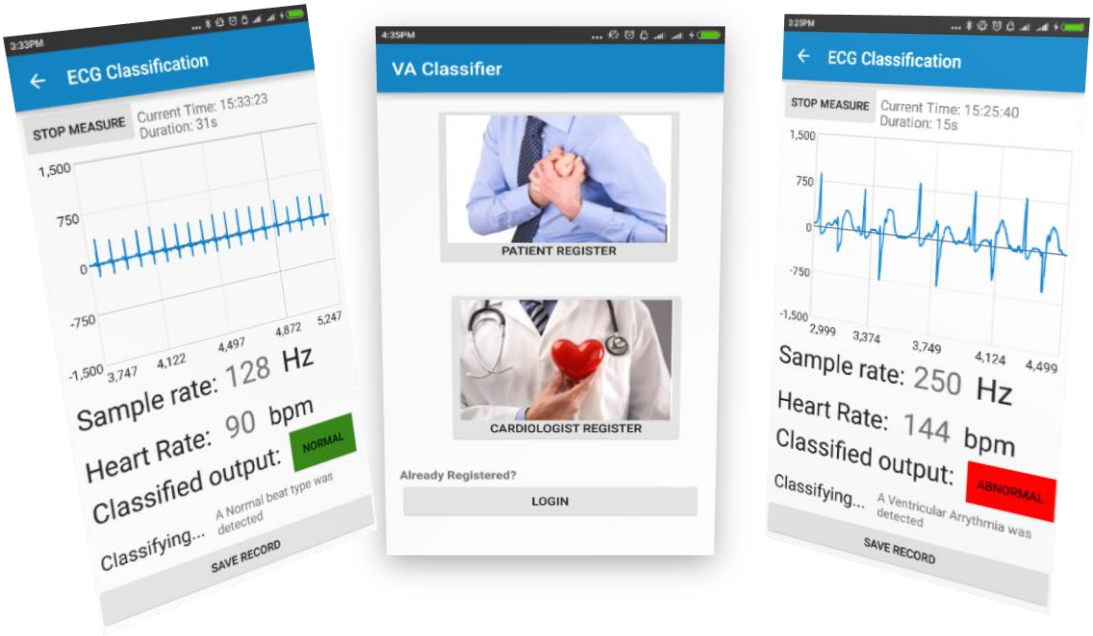

Figure 1 User Interface of VA-Classifier

6.0 Discussion

All of the objectives of VA-Classifier application have been achieved and explanation in Table 2.

Table 2: The Objectives and Their Achievements

Objectives	Achievements
To study and evaluate an algorithm for classifying ventricular arrhythmia in the application	A few algorithms, which are used to classify ECG, were chosen to study and one of the suitable algorithm was further selected to implement in this application.
To design and develop mobile application for classifying ventricular arrhythmia using electrocardiogram	The system is designed using Agile methodology with review the developed work by sprint or weekly. This system is developed using JAVA programming language in Android Studio for android native apps. The functional requirement and non-functional requirements of the system are drawn using UML. All the use cases have successfully developed in this system.
To test the applicable and adoptability of developed mobile application	The application is tested by using black box testing and user-acceptance testing. The black-box testing was tested based on the functional requirement and behavioral of the system. In user acceptance testing, one student as a patient and a doctor is chosen to conduct this test.

Besides that, the strength of the VA-Classifier application is the uniqueness of this apps enables ECG recording management to be done with an application accessed by two users. This application allows patient to update and send their latest ECG recording to cardiologist and view advice given by cardiologist in the same application. Cardiologist is able to observe the latest ECG recording of the patient in order to monitor the patient's heart condition more frequently. This application enables users to notify their family or friends whenever the patient performs an ECG classification and the classified result can be sent via SMS. This application allows user to have a more understanding regarding the disease as this application is built in with the related information content about Ventricular Arrhythmia. All these achieved functionality shown are unique because most of the application available in the market stores are accessed or provided for on kind of user only, which is either patient or cardiologist only.

7.0 Conclusion

Android Electrocardiogram for classifying Ventricular Arrhythmia is a native android mobile application. It is used for the purpose of diagnosing and management of arrhythmias heart diseases. This system involves two users, which are patient and doctor. Patient can choose their electrocardiogram recording for classification. The classification result can be stored and restored at history pages. Doctor can view patient's classified result and giving advice on each of the electrocardiogram records to their patient.

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