

# **MECHATRONICS BOOK SERIES SYSTEM DESIGN AND SIGNAL PROCESSING VOLUME 1**

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## **Editors**

**Asan G. A. Muthalif  
Amir Akramin Shafie  
Siti Fauziah Toha  
Iskandar Al-Thani Mahmood**



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## CHAPTER 15

### Design of Software Tool to Detect QRS Complex from ECG Signal

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#### 15.1 Introduction

Heart disease has become the single biggest killer disease in the world [1]. The number of deaths caused by heart disease has been increasing year by year. In response to that global situation, numerous methods to treat heart disease have been developed. One method to diagnose a human heart condition is conducted through the electrocardiogram analysis. The electrocardiogram (ECG) is a diagnostic tool that measures and records the electrical activity of the heart in exquisite detail. It is performed to evaluate signs and symptoms that could indicate heart problems. The interpretation of these details allows diagnosis of a wide range of heart conditions.

The ECG device detects and amplifies the tiny electrical changes on the skin that are caused when the heart muscle depolarizes during each heartbeat [2]. At rest, each heart muscle cell has a negative charge (membrane potential) across its cell membrane. Increasing this negative charge towards zero (via the influx of the positive ions,  $\text{Na}^+$  and  $\text{Ca}^{++}$ ) is called depolarization, which activates the mechanisms in the cell that cause it to contract. During each heartbeat a healthy heart will have an orderly progression of a wave of depolarization that is triggered by the cells in the sinoatrial node, spreads out through the atrium, passes through "intrinsic conduction pathways" and then spreads all over the ventricles. This is detected as tiny rises and falls in the voltage between two electrodes placed either side of the heart which is displayed as a wavy line either on a screen or on paper. This display indicates the overall rhythm of the heart and weaknesses in different parts of the heart muscle [2].

The detection of QRS complex is important in the analysis of ECG signal. In a typical ECG record, three clearly recognizable waves appear with each heartbeat (Fig. 15.1). The first one is named P wave, the second is named QRS complex, and the third wave is named T wave. As we can see in Fig. 15.1 the R peak in the QRS complex is very high compared to the others. Thus, the value of R peak can be used as a parameter to decide whether the patient is suffering from heart disease or not.

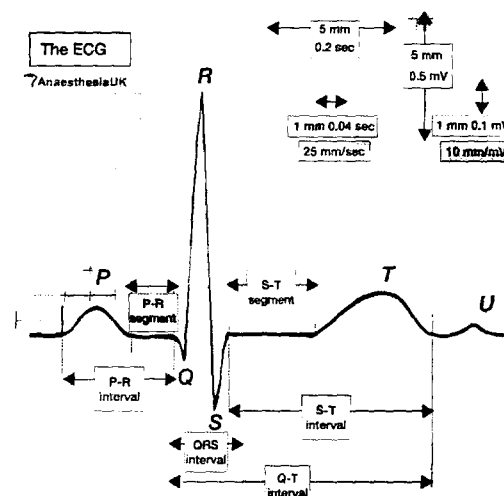


Figure. 15.1: Schematic representation of normal electrocardiogram (ECG) [3].