

Chapter 25

Healthcare Automation System by Using Cloud-Based Telemonitoring Technique for Cardiovascular Disease Classification

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ABSTRACT

This paper illustrates the cloud-based telemonitoring framework that implements healthcare automation system for myocardial infarction (MI) disease classification. For this purpose, the pathological feature of ECG signal such as elevated ST segment, inverted T wave, and pathological Q wave are extracted, and MI disease is detected by the rule-based rough set classifier. The information system involves pathological feature as an attribute and decision class. The degree of attributes dependency finds a smaller set of attributes and predicted the comprehensive decision rules. For MI decision, the ECG signal is shared with the respective cardiologist who analyses and prescribes the required medication to the first-aid professional through the cloud. The first-aid professional is notified accordingly to attend the patient immediately. To avoid the identity crisis, ECG signal is being watermarked and uploaded to the cloud in a compressed form. The proposed system reduces both data storage space and transmission bandwidth which facilitates accessibility to quality care in much reduced cost.

DOI: 10.4018/978-1-7998-8052-3.ch025

1. INTRODUCTION

Myocardial infarction (MI), a harmful cardiovascular disease (CVD), is one of the most serious causes of death worldwide, now a days. Every year, nearly 8 million deaths occur globally due to the above disease (WHO, 2017). MI, popularly known as heart attack is responsible for creating a global life-threatening circumstance. It is a fact that, more than 610, 000 people in the USA only get distressed by MI (cdc.gov, 2017) with annual direct estimated costs of over \$316 billion (Benjamin et.al, 2017). In the current scenario, it expands in an epidemic manner and will continuously destroy the heart muscles if not treated timely. So early and accurate detection of MI can improve the diagnoses quality and can effectively reduce the mortality rate in the world. As per the records of different statistical surveys, MI is becoming a major health burden also in India. The 70% rural population of India who lives in remote villages are found to be harassed in the name of timely accessible medical treatment, because of only 2% of specialist cardiologists are in rural areas. Hence, timely medical treatment for rural populations, reduce the increasing burden of CVD and total medical cost are crucial and demanding.

Cloud-based Telemonitoring service has the prospective strategy to enhance the primary care of CVD, which has the ability to reduce the increasing burden of CVD on healthcare system (Bashi et al, 2017). Telemonitoring services not only support the automatic analysis of medical data but also alert the first-aid professional for any important detectable changes. It has the potential to connect with the cardiologists, who recommended medication to the first-aid professional through the cloud server. The first-aid professional is attended to the patient needs accordingly.

One of the major concerns in the cloud-based Telemonitoring service is the healthcare data security and patient's privacy which will be a great impact for further success of cloud- based healthcare automation system. During cloud transfer or synchronization healthcare data are prone toward hackers with interconnected devices. So, this healthcare data must be protected from any kind of unlawful access. Watermarking technique can play a crucial role to protect healthcare data by combining the confidential information with the healthcare data.

The purpose of watermarking is hiding a message, called watermark, related to a digital signal (i.e. an image, text, song, and video) within the signal itself. Thus in a cloud based Telemonitoring system data security in the form of watermarking and authentication is very important.

The healthcare data produced by monitoring systems sometimes may be voluminous and range for long time period. The Huge amount of bandwidth is needed for the data transmission to the doctor's end. If the data is compressed, then these huge amounts of bandwidth may avoid. Hence an efficient healthcare data compression technique is required to reduce the huge amount of data as much as possible for analysis, storage and transmission (Halder et al, 2014a). The main target of any compression technique is to maximize the data volume reduction during the preservation of significant features and also to detect and eliminate redundancies in a given dataset.

This paper primarily focuses on the development of a primary level architectural framework for healthcare automation system using cloud-based Tele monitoring technique. In this system, the specialist Doctor is not needed in the initial stage. As a case study, ECG signal is used as a significant assessment tool. The patient should first turn up in the healthcare center for ECG testing and recorded ECG sent to the desktop via Bluetooth technology and consequently digitized ECG signal in voltage – time format is generated. Recorded ECG signal is being watermarked to avoid the identity crisis and transmitted to the cloud server in a compressed form (Halder & Mitra, 2015; Halder & Mitra, 2014b; Halder et al, 2014c) for a longer time. On the other hand, the proposed system removes unnecessary noise from the

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