

WIRELESS TELEMETRY FOR PULSEOXIMETER: DESIGN, DEVELOPMENT, AND TESTING

Khaldon Lweesy*, Hadeel Mahmoud, Rama Zaitoun, Raghad Farsakh, and Seleena Al-Khateeb

Biomedical Engineering department, Faculty of Engineering
Jordan University of Science and Technology, Irbid 22110, Jordan

Corresponding author: Khaldon Lweesy <klweesy@just.edu.jo>

ABSTRACT

Oxygen saturation of blood (SPO₂) and heart rate (HR) are two important vital signs to monitor patient's health condition. Having a wireless wearable pulseoximeter that can monitor these two vital signs continuously, and at the same time keeps the patient comfortable is of great importance. This paper describes the design, development, and testing of a wireless wearable pulseoximeter that allows monitoring of SPO₂ and HR from a remote location without requiring the physician to take the measurements. Measured data can be continuously collected and stored in patient's health care unit application, providing an excellent record for patient's medical status continuously. The hardware setup consists of an Arduino Nano microcontroller, which is a small, complete, breadboard based on the ATmega328, a Max30100 sensor, which is an integrated chip that is used for SPO₂ and HR detection, a Bluetooth chip (HC-06) that receives data from the sensor and sends it to the mobile application continuously, a 16 x 2 LCD for display, a Buzzer used for alarm, and some electronics. Data was collected from 27 people using the designed device and compared with results obtained from the commercial device Ohmeda 8300. Matlab program was used to calibrate the designed system and minimize the error percentage. The system was designed to give an alarm when the measured value exceeds the normal range. A mobile application was designed to receive data based on Bluetooth method, display the data on the mobile, with the ability to share data using different reading data programs.

Key words: wireless telemetry, pulseoximeter

INTRODUCTION

The Oxygen Saturation of blood (SPO₂) and heart rate (HR) are two of the most important vital signs to monitor patient's health condition. Both are considered important factors to access the conditions of the human cardiovascular system. To monitor these two vital signs continuously, and for patient's comfort, comes the need to develop the pulseoximeter to be wireless wearable device, and keep the healthcare unit with latest updates [1].

The heart is the most important organ in human body, it acts like a pump that transfer oxygenated and deoxygenated blood around the body. Heart rate can be measured by counting the time interval between two adjacent heart beats. The heart rate helps in diagnosing the health of the heart and predicting the existence of heart diseases [2]. Traditionally, HR is measured by pulse palpation. The pulse rate is measured by counting beats over a set period of time 60 seconds. Heart rate these days is monitored by a medical device that is a personal and portable heart monitoring tool which uses sensors that allows the users to measure and receive a feedback of their heart rate in real time under different physical situations.

Oxygen gas is necessarily for the survival of human beings. It is considered to be the key for generating energy in the cellular respiration. Oxygen enters our body by inspiration, passing through the respiratory system then through the circulatory system where oxygen inside the blood vessels connect to hemoglobin protein and thus called oxygenated hemoglobin (HBO₂). Oxygen circulates in the blood through the whole body, irrigating all kinds of tissue. Oxygen saturation (SPO₂) is defined as the percentage of oxygen saturated hemoglobin (HBO₂) relative to total hemoglobin in the blood, which indicates the capacity of blood carrying oxygen and is considered one of the most important vitals to monitor [3]. The invasive common method used to measure blood oxygen saturation is the arterial blood gas measurement test, which involves puncturing an artery with a thin needle and syringe and drawing a small volume of blood. A non-invasive method is now used to measure oxygen saturation using pulseoximeter based on an optical technique that can provide continuous real time measurements without any discomfort for patients [4].