

# Physiological measurement platform using wireless network with Android application



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## ABSTRACT

Currently, many people suffer from arrhythmia or hypoxia, which are abnormal health conditions. Arrhythmia occurs when a person has an irregular or abnormal heart rate, while hypoxia is realized when there is a deficiency in oxygen reaching the tissues. When a person suffers from arrhythmia, there is the possibility that the person has cardiovascular disease. A low oxygen level eventually leads to organ failure, which can result in death. To prevent such conditions, a mobile physiological measurement platform has been proposed in this paper. This system will continuously monitor the heart rate and the oxygen level of a patient. The proposed system is mainly beneficial because the medical staff or the caregiver can provide care to patients without being in close proximity. In this way, multiple numbers of patients can be treated by the physician at the same time. In this paper, two main physiological signals: the electrocardiogram (ECG) and the photoplethysmogram (PPG) are recorded, to measure the heart rate (in beats per minute) and the peripheral capillary oxygen saturation level or SpO<sub>2</sub> (in percentage) of the patient. This is done by using a convenient graphical user interface (GUI) in the Matrix Laboratory (MATLAB). Pre-processing of the bio-medical signals is done in the GUI and the calculated results are saved as text files in the current directory of MATLAB. We further propose an Android application, which will display the physiological parameters after the text files have been accessed via a wireless network. The heart rate and the oxygen level can both be monitored via this application. In case the results show an abnormal reading, the physician is notified immediately via text messaging.

## 1. Introduction

In science and technology industries, it has been observed that whenever a person is exposed to overwork, it mostly leads to fatigue. If this condition continues unattended this might lead to other complications such as heart diseases and sometimes even cause a major drop of oxygen level in the body. It eventually becomes fatal for that person. Likewise, a large number of workers who are exposed to heat environments die due to cardiovascular diseases every year [1]. The present world population also has an increase in the number of aged people who seek health care. The majority of them live alone or remain inside their home. They rarely have any assistance or necessary medical attention. Moreover, without any symptoms of diseases, it becomes difficult to provide care at home. Hence, in case of emergency situations, if the patients do not get the immediate medical care, the chances of death become high [2]. Therefore a health care system for monitoring the vital signs of the human body would be a smart way to prevent such situations. These vital signs which include body temperature, heart or pulse rate, respiration rate, blood pressure and oxygen

saturation level, are measurements of the body's most basic functions which are useful in detecting or monitoring medical problems. If a system is developed, which will continuously measure the physiological parameters as well as simultaneously inform the caregiver about the patient's health condition, and then it is possible to provide care to the patient, before any emergency condition is reached.

This paper proposes a physiological signal processing platform, which measures two physiological parameters: heart or pulse rate and oxygen saturation level. The physiological signals are processed using a graphical user interface (GUI) and the results are saved as text files in the current directory of MATLAB. These saved results are monitored with the help of an Android application (Android app). The application is designed in such a way, that it can read the saved results in the text files on the laptop or PC where they have been saved. The files are accessed through wireless network. In case the accessed results have any abnormal readings, then an alarm starts buzzing which alerts the user. Additionally, a text message is sent to the physician or the caregiver immediately, so as to alert him/her about the abnormal health conditions of the patient.

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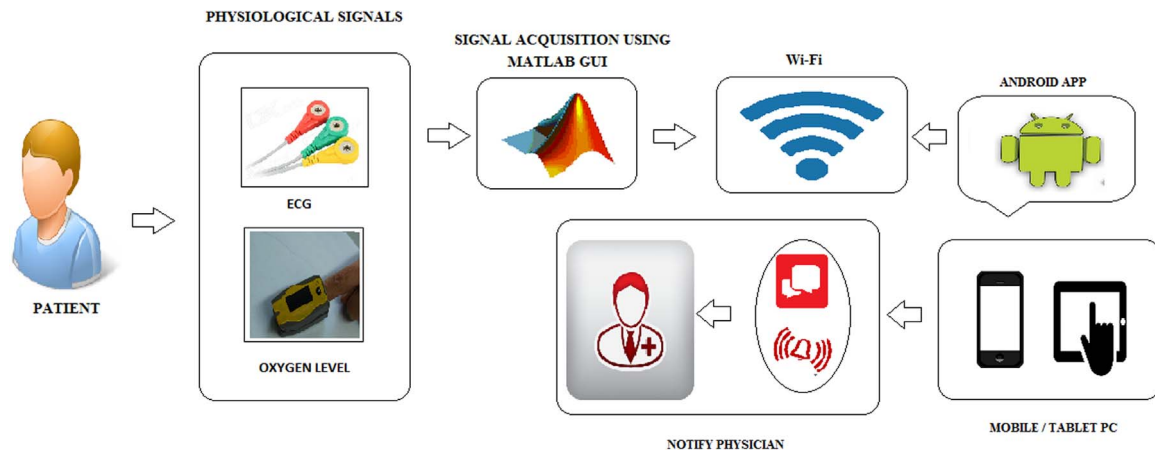


Fig. 1. System architecture diagram.

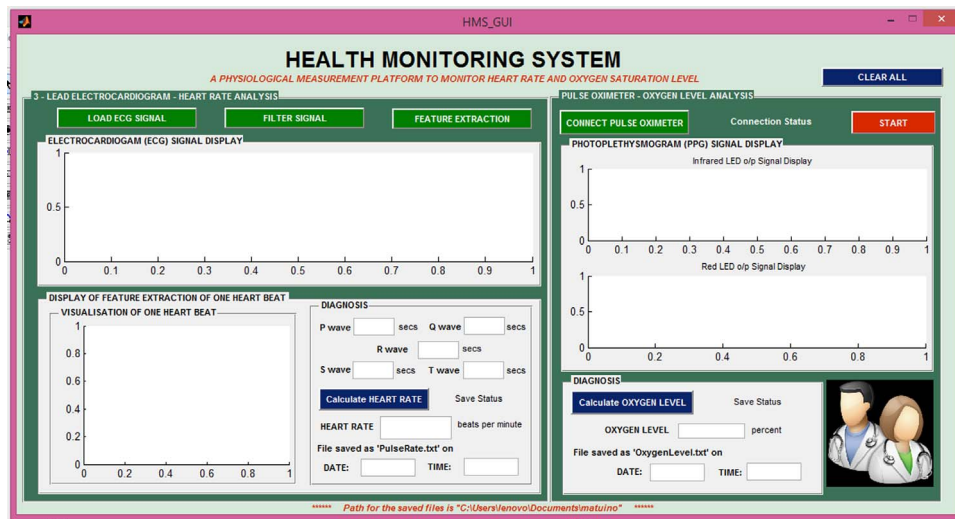


Fig. 2. MATLAB GUI of proposed system.

The paper is organized as follows: [Section 2](#) compares and contrasts the study with published works on the proposed system; [Section 3](#) describes the proposed system and its architecture; [Section 4](#) is the implementation of the system and [Section 5](#) is the results after implementation of the system. [Section 6](#) compares and contrasts the study with published works in literature. Finally, [Section 7](#) draws conclusions upon the proposed system.

## 2. Literature review

Wen-Tsai Sung et al. [1] has proposed a physiological measurement system which monitors the physical condition of the users. It helps them to maintain healthy physiological conditions. The system is an amalgamation of three physiological signal acquisition modules: an ECG module, a blood pressure module and an oxygen saturation module. These three modules will record the physiological signals and then send the data to a mobile device. Their system focuses upon three communication system for data transmission. They are RS-232 serial port wired transmission wireless, ZigBee, and Bluetooth. The physiological signals are viewed on an Android mobile device. The physiological data received by the mobile device are immediately sent to the cloud server with the help of Internet. A personal physiological database is maintained in the cloud server, which is used to determine the best personal physiological data. These values are used to set dangerous levels of the physiological parameters for preliminary diagnosis. The extreme levels are set according to the personal

physiological details of the patient. When the physiological data cross these designated extreme levels, it immediately warns the user to get the necessary medical aid. The system also incorporates video equipment to enable remote diagnosis. Therefore, the system is able to provide consultation by medical units.

RenGuey Lee, et al.[2] puts forward a system to prevent and control physiological parameters affected by the two chronic diseases: hypertension and arrhythmia. The proposed system is a role-based intelligent mobile care system with alert mechanism. The roles in the system are patients, physicians, nurses, and health care providers. Each of these persons uses a mobile phone device to communicate with the server setup. This system uses physiological signal recognition algorithms in commercial mobile phones with Bluetooth communication capability without disturbing the normal functions of the device. Therefore, several front-end mobile care devices with the Bluetooth communication capability are integrated to extract the physiological parameters of the patient. The physiological parameters are blood pressure, pulse, saturation of haemoglobin and electrocardiogram (ECG). These physiological signals are uploaded to the health care centre for storage, analysis and transmission of the information to physicians and health care providers. The physiological signal extraction devices deal with signal extraction and wireless transmission. An alert mechanism has been added in back-end of the health care centre to automatically inform the users after recognizing emergency conditions.

William Walker, et al. [5] proposed a system to monitor the blood

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