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Biomedical Engineering

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Wireless Wearable Pulse Oximeter Sensor

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Abstract

This project aim is designing a wireless wearable plus oximeter .there is two unit , the first one to measure ,calculate and transmit the heart rate and the oxygenation (sensor unit). The second unit contains from the receiverand PC to receive the data and display it in the PC using graphical user interface (PC unit) . the design is unobtrusive comfortable for long term wear ,portable ,low power consummation and remote monitor .there are many people who will benefit from the ability to have a constant with plus oximeter that does not interfere with their daily activities . similar products are expensive and offer Less options.

The sensor unit is consists of a soft silicon ,preprocessing circuit ,processing unit and transmitter circuit . the soft silicon houses the LEDs (light emitting diode) and photodiode necessary for obtaining plus oximeter data ,preprocessing circuit for convert the current to voltage and filtering the signal , processing unit to calculate the heart rate and the oxygenation and transmitter circuit to transmit the data using radio frequency to the second unit .

The PC unit consists of RF receiver , microcontroller unit ,USB to UART and PC .The RF receiver to receive the data from transmitter in wave form ,the microcontroller unit to obtain the data from the signal ,the USB to UART to convert the data from serial to UART and contact the receiver circuit with PC and PC using for display the data using GUI.

المستخلص

الهدف من هذا المشروع هؤ تصميم دائرة(plus oximeter)لا سلكي يمكن ارتداءه مكون من وحدتان الاولي لقياس وحساب وارسال معدل نبضات القلب والوحده الثانيهتحتوي علي مستقبل والكمبيوتر الشخصي لاستقبال البيانات المرسله وعرضها علي الكمبيوتر الشخصي با ستخدام نافذة عرض البيانات.

هذا التصميم خفيف ومريح ويمكن ارتداه لفترات طويله .الطاقه المستهلكة منخفضه ,وله خاصيه المراقبه عن بعد,هنالك العديد من الاشخاص الذين يمكنهم ان يستفيدون منه لان له قابلية القياس بصوة مستمره كما انه لا يتداخل مع نشاطاتهم اليومية. المنتجات المشابهة تكون مرتفعة الثمن ولها عدد قليل من الخيارات.

تتكون وحدة القياس من حساس,دائرة للمعلجه المبدئية ,وجدة المعالجه ,دائرة الارسال . يتكون الحساس من (2LED)وثنائي ضوئي لاستقبال الضوء واعطاء اشاره في شكل تيار.

دائرة المعالجه المبدئيه تقوم بتحويل التيار الي جهد ومن ثم تعمل علي تنقية الاشارة ,كما تقوم وحدة المعالجة بحساب نبضات القلب ونسبة الاكسجين في الدم وارسالها باستخدام موجات الراديو.

اما الوجدة الثانية فمكونة من الكمبيوتر الشخصي يحتؤي علي مستقبل موجات الراديو والمتحكم (USB to UART)مستقبل موجات الراديو يقوم باستقبال الاشاره في شكل موجات وجدة التحكم تحافظ علي شكل الاشارة يحول البيانات من serialاليUART ويربط دائرة الاستقبال بالكمبيوتر الشخصي الذي يستخدم لعرض البيانات عن طريق نافذة عرض البيانات.

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1.1 Introduction:

Oximetry is the measurement of transmitted light through a translucent measuring site to determine a patient's oxygen status noninvasively. Oximetry measurements can be traced to the early 1930's when German investigators used spectrophotometers (instruments that measure different wavelengths and intensities of light) to research light transmission through human skin. In 1934, one investigator reported measuring oxygen saturation in blood flowing through closed vessels in animals [1, 2].

In 1939, German researchers reported use of an "ear oxygen meter" that used red and infrared light to compensate for changes in tissue thickness, blood content, light intensities and other variables. However, it was not until World War II that interest in oximetry took hold [1].

Today there are many manufacturers of pulse oximeters. All offer a variety of different oximeter boxes with SpO2 (oxyhemoglobin) and pulse rate readings, waveform displays, alarms, etc. While the boxes and the displays may differ, they use a similar method of measuring oxyhemoglobin saturation by two wavelengths of light in the red and infrared range. But while the two-wavelength method is used to start the SpO2 measurement process, the way the signals are processed after that point, play a major role on how accurate the readings will be, especially through motion and low perfusion [1].

During the late 1990's and into the next decade, 'new generation' pulse oximeters have been introduced that have elevated the accuracy of pulse oximeter readings significantly [1].

Wireless technologies used in medical field prevent patient comfort and good quality medical service . pulse oximetry is one of the important medical test that can use this technologies in observation of patient continuously [1, 2].

1.2 Problem statement

Previously, there have been a number of medical systems for specialized occupations. These previous systems suffer from a number of serious drawbacks, for example:

1. Small in size.
2. Low cost.
3. High accuracy.
4. Provide continuous patient monitoring at home/hospital.
5. Enables the patient's mobility.

Tremendous methods and techniques have been introduced to improve and overcome these drawbacks such as:

1. Using rechargeable batteries .
2. Wireless communication links.

1.3 Objectives of the project

The main objectives of the current project is to design, prototype, and test a wireless pulse oximeter system that perform the followings

1. Continuous patient monitoring
2. Home monitoring for chronic and elderly patient
3. Small in size
4. Low cost
5. High accuracy

1.4 Research Methodology:

The goals of this research are mainly achieved by dividing the process of investigations into three stages. The first stage concerns with the Design the circuit. The second stage clarify the process of connecting the hardware component of the device as well as testing the device after each stage of connection. At the end comes the third stage that explains the process of programming as well as testing the overall performance of the device. All these steps are described in figure (1.1) as the methodology of the research.

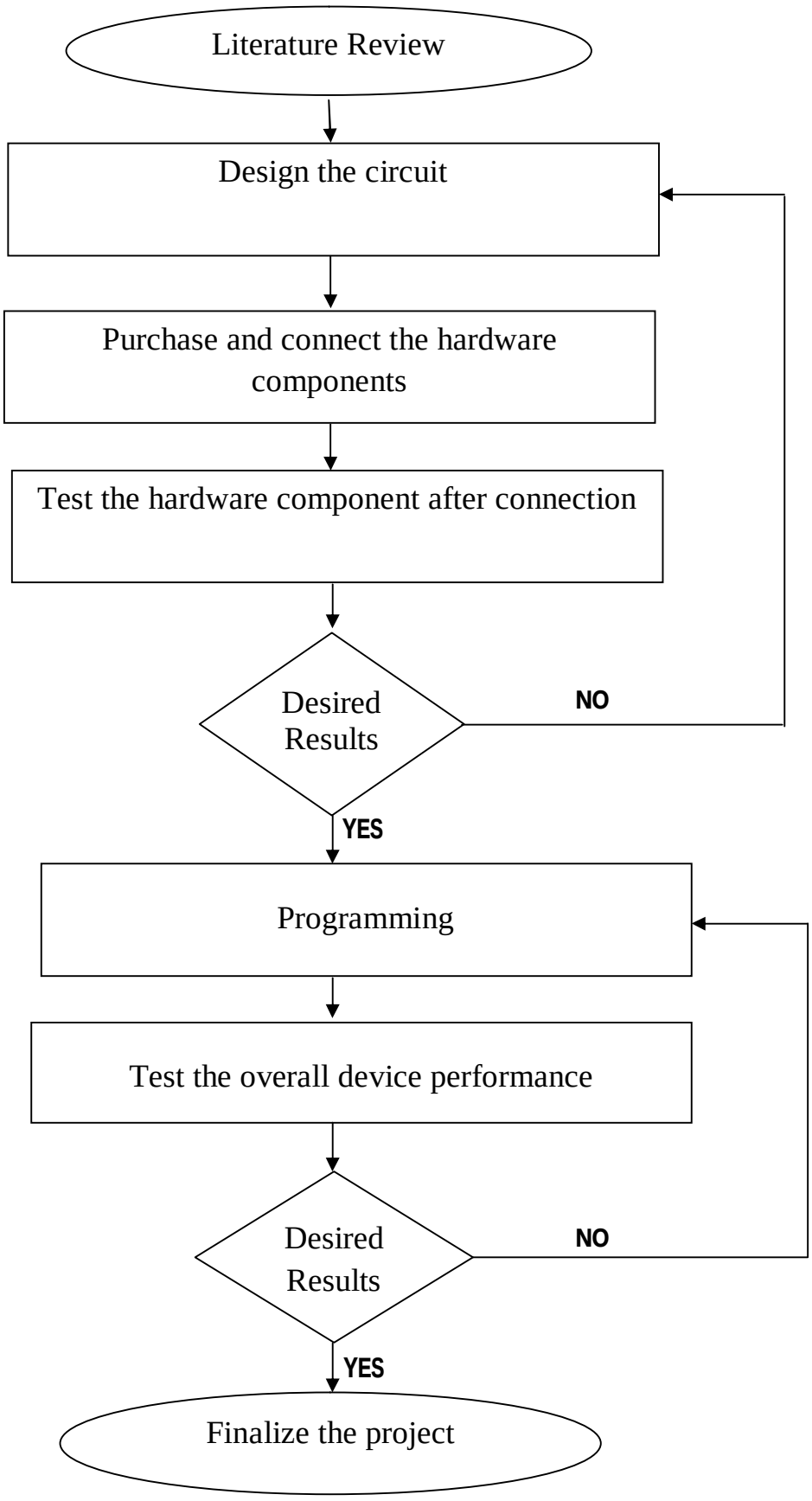
Literature Review
Design the circuit
Purchase and connect the hardware components
Test the hardware component after connection
Desired Results
NO
YES
Programming
Test the overall device performance
Desired Results
NO
YES
Finalize the project

Figure (1.1): Research Methodology

1.5 Scope of the Study

In this research, an effort has been made to study and investigate the possibilities designing and fabricating a wearable wireless Pulse Oximeter system. The major scopes of this research are detailed as follows:

i. Study and understand the usage of pulse oximeter sensor and their possibilities of replacing rigid pulse oximeter by a wireless wearable pulse oximeter.
ii. Conduct simulation and experiments techniques to investigate, examine and categorize each component required and necessary for designing the wearable wireless system.
iii. Evaluate and compare measured results and consequences of the wearable pulse oximeter system with simulated results.
iv. Finalize the designs, compile reports, and produce regional/international conferences and journal papers.

1.6 Research Organization

The thesis consists of seven chapters. The current chapter discusses the problem definition, justification for carrying out the research, and objectives. The chapter is introduced with the vision of the emerging technology between pulse oximeter concept and wearable systems, followed by applications of wireless wearable pulse oximeter system.

Chapter 2 reviews some of the previous researches on wearable systems considering non wireless pulse oximeter systems as well as other wireless wearable devices. The research also discusses several pulse oximeter devices proposed previously based on different designs and variable types of components.

Perceptions, principles and requirements of pulse oximeter system intended for wearable applications are introduced in Chapter 3. The applications of wireless wearable pulse oximeter system, as well as important design considerations related to wearable systems designs are also discussed.

Chapter 4 presents the Circuit design of the research with brief fundamental concepts related to pulse oximeter system designs

In Chapter 5, the software procedures where the microcontroller is programmed along with the options available for the purpose were discussed. Also the graphical user interface that had been chosen to work with and display the SPO2 and heart rate values in a PC after the transmission process will also be discussed.

Chapter 6 discusses and presents results obtained by the design, where results achieved in this project and some troubles that have been in the research path. The chapter discusses the device final design that have been tested to indicate the final results achieved as well as the efficiency of the device.

The conclusions are stated in Chapter 7 together with the findings summary of the research and suggestions for other areas of additional researc