Heart–Rate Monitoring with Photoplethysmography (PPG) Sensors

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Introduction
• Photoplethysmography (PPG) is a simple technique used to detect volumetric changes in blood in peripheral circulation by optical means, particularly low–intensity infrared (IR) light.
• The movement of IR light through biological tissues enables its absorption which is considerably more towards blood in comparison to its surrounding tissues.
• Alterations in blood flow are easily perceived by PPG sensors as changes in the intensity of light.
• The following steps were followed to construct a functioning PPG system to create a waveform graph of one’s heartbeat, thereby accomplishing the objective:

  Design printed circuit board on EAGLE software
  Fabricate printed circuit board
  Monitor heartbeat with DAQ & LabVIEW

  Depiction of printed circuit board schematic on EAGLE (below)

Printed Circuit Board (PCB)
• EAGLE is an application that specializes in electronic design automation, which features a schematic editor and fundamental PCB layout tools.
• We predominantly relied upon EAGLE to (1) construct a schematic and (2) convert the aforementioned schematic into the PCB format.
• In order to create a schematic and, subsequently, an operating board, one must accomplish the following:

  Browse library of components and place appropriately upon map
  Wire each constituent and convert document to PCB format
  Complete necessary alterations and auto-route components
  Generate Gerber files and submit to manufacturer
  Solder each element on the PCB and test it to ensure effectiveness

Objective
• Photoplethysmographic technology is noninvasive and relatively inexpensive, aspects of the methodology that sanctions its usage in heart rate monitoring, among several other things.
• Overall, our objective is to create a simplistic device that accurately and effectively monitors one’s heart rate with PPG.

LabVIEW and Final Testing
• LabVIEW, a systems engineering software for applications that require test, measurement, and control, was primarily relied upon to create a program that would ultimately generate a waveform graph of one’s heart rate.
• In order to accomplish the aforementioned objective, one must program a data acquisition (DAQ) application with NI–DAQmx functions.
• Ultimately, the printed circuit board is connected to the following to enable the creation of a sinusoidal graph depicting heart rate:

  Data acquisition component, USB–6009
  Heartbeat sensor, which allows LabVIEW to receive signal exuded from DAQ

  Depiction of resting heart rate in LabVIEW software (above)

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