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Phys 420C
Annotated Bibliography for: Circuitry and the Heart

Legend: As with any research project, a great place to start is by making an annotated bibliography. Like a regular bibliography, the source is listed as well as date accessed and authors (if present). Annotations were added below the source, providing a brief summary of the information as well as notes describing (possible) usefulness to the project at hand.

Web sources:

Circuit Building

#1

Mercer, D. "Activity: Heart Rate Monitor" (2018, Jan 11) (Sept. 10, 2019),
<https://wiki.analog.com/university/courses/alm1k/alm-lab-heart-rate-mon>

This website is essential to my project. It provides background information, schematics and parts needed to make a heart beat sensor without a finger clip. It also lists the functions of the components needed. For example, the functions of the amplifiers and low-pass filters can be found here. These will be necessary in fine tuning my signal. Demo 2 was based on this design.

#2

Instructables, rajbex. "Microcontroller Measures Heart Rate Through Fingertip." *Instructables*,
Instructables, 1 Nov. 2017,
www.instructables.com/id/Microcontroller-measures-heart-rate-through-finger/.

This website as suggested by its title provides instructions on how to assemble a heartbeat sensing circuit. This resource may be used to cross reference the information in resource 1 on this list as they are very similar. This website provides a link to an alternative circuit that utilizes an Arduino microcontroller that connects to a finger clip sensor.

#3

"Arduino Measures Heart Beat Rate from Fingertip." *Embedded Lab*, 8 May 2015,
embedded-lab.com/blog/arduino-heart-rate-meter-seven-segment-led-display/.

This website provides a link to an alternative circuit that utilizes an Arduino microcontroller that connects to a finger clip sensor. Another appealing component of this source is the "Troubleshooting" section. This will come in handy during the fine tuning stage of my project.

#4

Heart Beat Monitoring Circuit Diagram Using PIC Microcontroller and Pulse Sensor, www.circuitdigest.com/microcontroller-projects/heartbeat-monitoring-using-pic-microcontroller-and-pulse-sensor.

Another website describing a circuit for measuring pulse. This is a much simplified version of the circuit, only requiring about 10 components. Unlike source #3 on this list, this website utilizes a PIC microcontroller instead of Arduino. Furthermore, this circuit does not utilize a pre-built sensor clip, but instead uses one made with a velcro strip. This website also goes into depth on the code, the microcontroller utilizes to collect and display data from the heart and how to interpret and modify it.

#5

Science Buddies. "Make a Heart Rate Monitor: Science Project." *Science Buddies*, Science Buddies, 22 Mar. 2019, www.sciencebuddies.org/science-fair-projects/project-ideas/Elec_p091/electricity-electronics/make-heart-rate-monitor-circuit#materials.

As the title suggests, this is another circuit building website, that will contribute to the design and methodology of the heart rate monitor circuit that I will be making.

#6

Ravi, et al. "Heartbeat Sensor Using Arduino (Heart Rate Monitor)." *Electronics Hub*, 24 Jan. 2019, www.electronicshub.org/heartbeat-sensor-using-arduino-heart-rate-monitor/.

This and the following website also go into depth on how to build heart rate monitoring circuits. They will be compared and contrasted with the other five circuits websites listed above as well as the journal articles below. This site was used heavily for my project. Model 3 was based on Ravi's design and was able to run on his code as seen in demo 3b.

#7

Swagatam, About. "Heart Rate Monitor Circuit." *Homemade Circuit Projects*, 3 July 2019, www.homemade-circuits.com/heart-rate-monitor-alarm-circuit/.

Background Information

#8

OpenStax, Lumen Learning &. "Anatomy and Physiology II." *Blood Flow, Blood Pressure, and Resistance | Anatomy and Physiology II*, (Sept 10, 2019) www.courses.lumenlearning.com/suny-ap2/chapter/blood-flow-blood-pressure-and-resistance-no-content/.

This website is more biophysics related. It has extensive detail on blood flow, blood pressure and pulse. Various properties of blood, such as viscosity, are also listed. This information will be crucial to my presentation. It will contribute to my background knowledge of blood flow in the body.

#9 used

“Anatomy and Circulation of the Heart.” *WebMD*, WebMD, (Sept, 12, 2019)
www.webmd.com/heart-disease/high-cholesterol-healthy-heart.

This is a great preliminary resource for learning about the heart. It lists basic terminology of the structure of the heart as well as how blood is pumped through them. After looking at this source, I will come up with questions to ask myself for further research. Web md is also a common website used by young adults and is written in a way meant to be easily interpreted (perfect for senior high school level).

#10

“Blood Pressure vs. Heart Rate (Pulse).” *Www.heart.org*,
www.heart.org/en/health-topics/high-blood-pressure/the-facts-about-high-blood-pressure/blood-pressure-vs-heart-rate-pulse.

This website goes into depth about blood pressure as well as heart rate. This website briefly describes the link between them. It also describes the ways they are not linked as they do not “necessarily increase at the same rate.” Many high school physics students may not have taken biology and/or may not much about the human body, making this information necessary for my demo.

Articles

#1

“Microcontroller Based Heart Rate Monitor”
(Fezari, M. et al), *International Arab Journal of Information Technology*, volume 5(4), page 409-413, 2008

This article has very few citations. However, it has useful images, diagrams as well as background information. The introduction has useful information on infrared light sensors as well as an image of a finger hovering over one. This article, unlike others on this list, utilizes a PIC microcontroller, not an Arduino one. As this it provides great comparison between the two types of circuits.

#2

“Wireless Heart Rate Monitoring System Using MQTT”
(Chooruang, K. et al.), *Procedia computer science*, volume 86, page 160-163, 2016

This article describes a circuit using arduino microcontroller to measure heart rate. In this article, the data taken from the device was compared to manual measurement, showing an error of less than 5% (162). This provides a good in class activity to include in the presentation of the demo. For example, students may group up, and manually measure their heart rates and compare to the values provided by the machines.

Notes:

Use block and circuit diagram

Info in methodology

#3

“Ambulatory Health Monitoring System Using Wireless Sensors Node”

(Fezari, M. et al), Procedia computer science, volume 65, page 86-94, 2015

This article has more intermediate level information. This paper describes a heart rate monitor and ECG with wireless sensing capabilities. This article also has information on arrhythmias and how they may be detected. The hardware section has useful information on the microcontroller and other components. The software and results section may also be useful.

#4

"Design and Implementation of a Heart Rate Monitor"

(Igrimoh, J.A. et al), Advanced Materials Research, volume 824, page 145-150, 2003

#5

“Integrated system for remotely monitoring critical physiological parameters”

(Alexakis, S et al.), Journal of physics. Conference series, volume 637, page 012002, 2015

This article talks about measuring various physiological parameters of the human body. It explains how the authors used an arduino microcontroller and microprocessor to export data to Google sheets, a software easier to understand and access for myself and the students I will be presenting to. The introduction, circuit schematics and data tables may also serve as useful comparables later on. They also tested their data with a simulator under conditions such as no noise, line noise, tremors. I should consider using a similar strategy.

#6

“Design And Development Of A Microcontroller Based System For The Measurement Of Blood Glucose”

(Sunitha, U. et al.), International journal of engineering research and applications, volume 2(5), page 1440-1444, 2012

This article is a valuable resource as suggested by its title. The introduction provides information about the pulse or heart beat and its importance. The methodology section explains how the

intensity of infrared light reflected by red blood cells is used to calculate pulse (146). This information is fundamental for explaining how my demo works. Trials were also run on students engaging in physical activity (higher heart rate). This provides comparable data for both my fine tuning and possibly my live demo.

This article is less likely to be used compared to others on this list. The actual technology used in and results of the project in this article are a little hard to follow. Also as the title suggest this circuit is more for providing blood glucose information and not quite a heart beat monitor.