

Real-Time Display of Heart-Rate Monitor Data

Project Proposal

CMP060L050H

MSc Project

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Introduction:

Sports and exercise science is an emerging field rapidly increasing in popularity and importance. With a global sports market growing by 13.39% in 2021 and nearly 32% in the three years since the pandemic, businesses in the world of sport are striving to deliver world-class results and performance.¹ The resulting pressure on professional athletes to perform well is high, ensuring the need for optimal development and a competitive edge against opposition.² In addition, the ever-present goal to improve overall human health has led to recent exponential growth in the field of sports and exercise science.³ This has led to important research in the interest of optimizing human performance, decreasing injury risk and improving injury recovery. The University of Roehampton is not only contributing to this research, but also teaching a new generation of Sports and Exercise Sciences students. The department finds that their current methods of utilizing heart-rate monitors in their lab for educational purposes are not meeting their needs. The motivation for this project is to address this need by creating a website that can connect to multiple Bluetooth heart-rate monitoring devices and display live results. In order to complete this task, research into the field of monitoring devices, Bluetooth Low Energy, ANT+ and API connections will be necessary.

Problem Statement:

The Sports and Exercise Department at the University of Roehampton routinely uses heart-rate monitoring devices in classes to access real-time heart-rate data. The current devices employed by the department use out-of-date technology, only allow for personal results to be seen on individual watches or devices, and are cumbersome to use. This current method is

suboptimal and in order to improve efficiency and productivity in their classes, the department seeks a platform to easily view live heart-rate data from multiple heart-rate monitoring devices in one display.

Aims and Objectives:

The main goal of this project will be to meet the needs and desires of the Sports and Exercise Department, by providing them a platform to integrate with their heart-rate monitoring devices to view live results on a display. However, this can be broken down into a few sub-objectives for this project. The first challenge will be to determine how to connect the heart-rate monitoring devices to our platform and to receive data from the devices. Most modern heart-rate monitors utilize Bluetooth Low Energy (BLE) to transmit heart rate data wirelessly. BLE is a power-efficient version of Bluetooth designed for low-power devices like fitness trackers and heart-rate sensors.⁴ Heart-rate monitors with BLE can be paired and connected directly to phones, computers or other compatible devices that support BLE. This allows the heart-rate data to be transmitted from the monitor to the receiving device in real time.⁵ Some modern heart-rate monitors additionally utilize ANT+ technology, which is optimized for ultra-low-power, short-range wireless communication.⁶ Its major difference from BLE technology is that it allows for multiple connections simultaneously, which may be beneficial for the context of this project.⁶ All in all, a BLE or ANT+ connection from the monitoring devices to the device receiving the data will be required. This may require an additional receiving device attached to the main computer, should it not have BLE or ANT+ receiving capabilities (most likely the computer at the lab). In meeting with Ryan Knight, our contact at the Sports and Exercise Department at the University

or Roehampton, we were able to assess the heart-rate monitoring devices currently in use. The majority of these devices are Polar T31 Coded Transmitters. Unfortunately, these devices use out-of-date technology, GymLink (5khz transmission), to connect the monitors to various gym related devices such as Polar watches and upright bikes. Without BLE or ANT+ capability, these devices will not be sufficient to achieve the desired end product. However, the Sports and Exercise Department is hoping to expand their collection of heart-rate monitoring devices to meet the needs of this project. They are currently testing a new Polar heart-rate monitoring model, the Polar H10, which includes both BLE and ANT+ functionality. It will be determined in the near future which devices the department will choose to purchase, however we can be certain it will include both of these new vital connectivity technologies. Once the devices have been successfully connected and our computer is receiving accurate data, the next objective of this project will be to design and implement the webpage to display these results. This will most likely involve an API to connect the heart-rate data to the website. There are various open-source APIs for BLE and ANT+ connections, as well as company specific APIs such as Polar AccessLink API.⁷ Ultimately, the choice of API will be influenced by the choice of heart-rate monitor devices, so future research will need to be conducted once a choice is made.

Additionally, user research will need to be conducted to extract the exact needs of the department for the display setup. This will include design and style choices as well. Finally, should the scope of this project allow it, the department would also appreciate a way to store this data for future analysis. This would require a database and additional research into the devices themselves and the data they transmit/store.

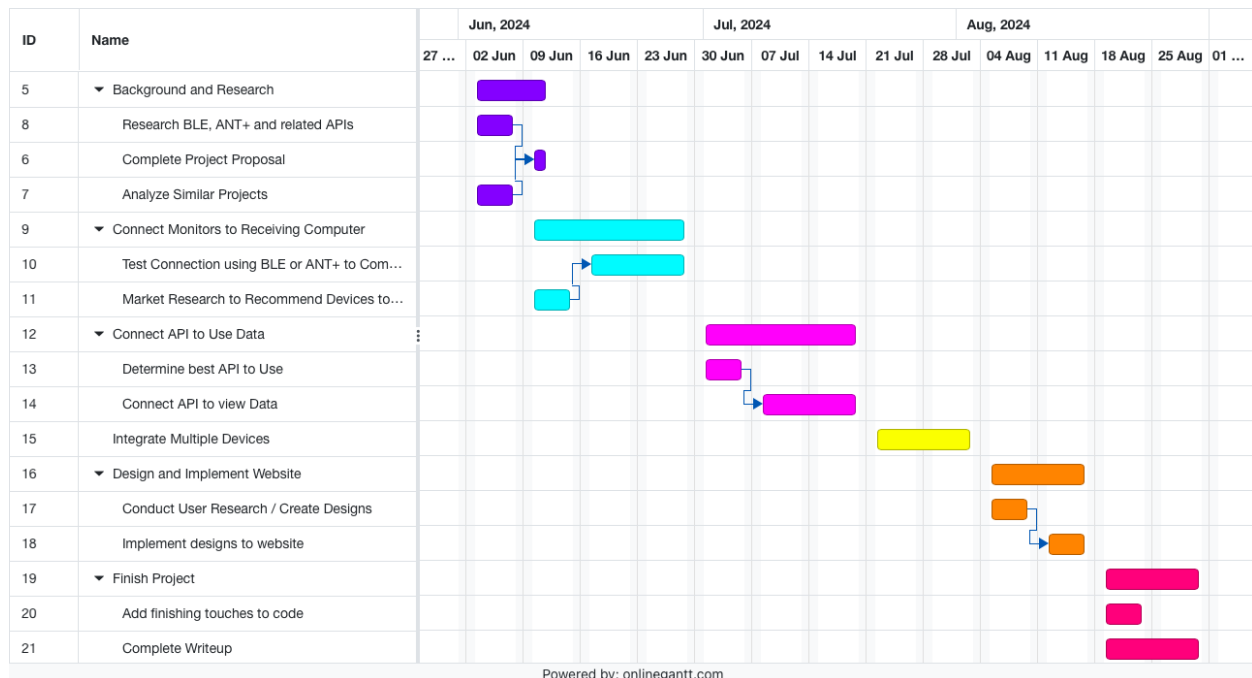


Figure 1: Gantt Chart outlining objectives and proposed completion dates.

Legal, Social, Ethical and Professional Considerations:

The use of Bluetooth to transmit sensitive health data from wearable devices raises significant privacy concerns. Bluetooth connections can be vulnerable, allowing malicious actors to intercept and access an individual's real-time heart-rate and other health information.⁵ Additionally, if this data is later stored in a database for analysis, sufficient security measures will need to be taken to ensure privacy. Consumers must be made aware of these privacy risks prior to using this proposed product.

Background:

BLE and ANT+ technologies are commonly used in conjunction with APIs to create websites and apps that display live heart-rate data from fitness devices and wearable monitors.

This is a topic that is well researched and frequently implemented. Many fitness device manufacturers provide APIs that allow developers to access the data from their devices, including heart-rate. These APIs define a set of rules and protocols for how apps and websites can communicate with the devices and retrieve data. For example in addition to Polar, Garmin provides the Garmin Health API that allows developers to access data from Garmin wearables like heart rate, steps and more.⁸ Examples of apps/websites using this approach include Strava, which can display heart rate data from connected devices, and the Peloton app, which can pair with BLE/ANT+ heart rate monitors during cycling workouts.^{9 10} Although applications such as these and many independent git-hub projects implement this functionality of displaying a real-time heart-rate from a device, I have yet to see an example of multiple monitors connected to one summarized display. The lack of background information on this aspect may prove difficult.

Here are a few examples of similar git projects for reference.

https://github.com/Tigge/openant/blob/master/examples/heart_rate.py

https://github.com/stuartlynnne/fitness_hrv

<https://github.com/fg1/BLEHeartRateLogger/blob/master/BLEHeartRateLogger.py>

<https://github.com/kieranabrennan/dont-hold-your-breath>

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Student and First Supervisor Project Sign-Off			
	Name	Signature	Date
STUDENT: I agree to complete this project:	Clare McMullen	<i>Clare McMullen</i>	18/06/2024
SUPERVISOR: I approve this project proposal:			
Supervisor Comments / Feedback			