Log Everything

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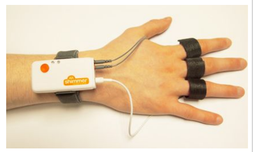
Abstract

The Log Everything project is a modular data logger commissioned by the Winfree Laboratories for use in their several projects as a universal data logging device, capable of logging theoretically any and all information types with a plug and play style of hardware setup. The original concept was to allow multiple sensors to record and log their data. In order to create our modular data logger, we would need to research channel monitoring and implement methods to monitor multiple channels and log the data from each sensor. Since data logging involves dedicated channel monitoring, we decided to create a modular bundle of sensors. The sensors in each bundle would depend on the project that they would be part of. The modular bundle itself is meant to simply and quickly attach to a central device with minimal upkeep and begin logging the required data with ease. Some knowledge of the equipment would be required for anybody who wants to use our data logger, since we did not create a standard plug and play device, instead we are providing guidance and instruction on how to implement our method into a selected project. The base device, as we have designed it, is capable of logging everything so long as the necessary modular devices are fabricated prior to use.

Research

Our research mainly consisted of looking into pre-existing data loggers and how they were implemented. In trying to picture what the final product would resemble, we looked for guidance in other mass produced data loggers that are specifically designed for use in athletic and medical applications.

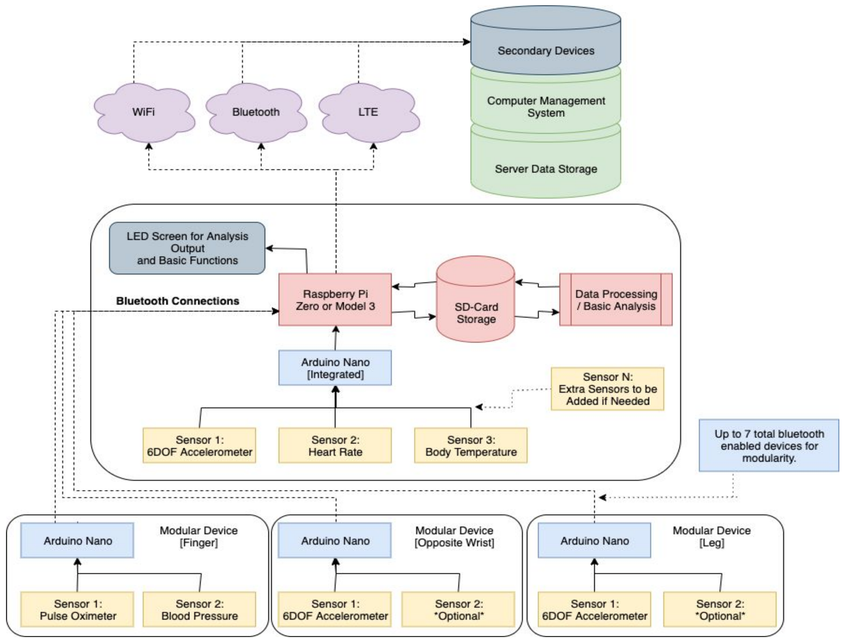


Much of our research discovered that many of these devices would attach to the user's arm and would store data locally to be later uploaded manually. The mobility aspect of these devices helped us design how the device will attach to the user via straps but posed the issue that these devices were very centralized on a single function, rather than a vast number of functions. As different sensor types have different criteria for use, we have settled on a design that makes use of modularity, so that the Winfree labs have the ability to make a multitude of these devices for different applications, such as tracking leg movement, GPS tracking of one of their GoBabyGo vehicles, or even heart rate tracking from a chest monitor. Through the use of Bluetooth connections between modules and the main device, all these applications can simultaneously and simply be used to start tracking the data needed.

In designing the more technical aspects of our device, much of our research was focused on bluetooth functionality, as well as individual research of the hardware we would need to use. From this research, we learned that a single bluetooth device can handle up to seven different connections to other devices at one time. This functionality allows for us to handle several modular devices as well as direct connections to computers for data transferring. Sparkfun as well as Github was able to provide us with a lot of different insight into how many of our sensors and hardware devices function, with instructions on how to direct the programming and plug into the main device.

Engineering Design

Design Approach



- Modular sensor bundles allow for easy integration into the project, allowing for a plug and play style of data collection once modular devices are fabricated.
- Fabrication of modular devices separate from the main device allows for simple integration of new sensors and data types with minimal upkeep needed.
- Local Storage exists on each device, including the modular devices, to allow for data preservation during connection interruptions.
- The primary device is capable of connecting to servers for data upload via local WiFi, Bluetooth, and cellular LTE networks.
- Basic levels of data processing is necessary for the onboard controller to handle as certain sensor outputs are relative readings and are meaningless without needed context.

Results and Conclusion

Our project had three main components data logging, modularity, and bluetooth capability. Ideally, a user could choose what sensors they wanted to log data from and the finished log everything device would be able to detect the chosen sensors, log the data to a local storage device such as an SD card, and then wirelessly transmit the data via bluetooth to a server were it could be read by the user.

The goal of the first component, data logging, was to log the data on an SD card. This would ensure that no data would be lost due to connection issues.

Our second component, modularity, was aimed at ensuring our device could be used in various different situations that required data logging. Ideally, one would be able to choose what type of data they wanted to log, select a device that recorded the type of data they chose, connect the device with ease to the log everything device, and begin logging data. The third component, bluetooth capability, would allow the logged data to be sent wirelessly via bluetooth. This wireless transmission of data would allow the user to access the collected data without having to return to the device.

Concepts

- Bluetooth Low Energy (BLE) is the primary wireless area network concept we used for our application design. This selection was made due to the wide commercial use of BLE in fitness trackers and activity monitors.
- A Serial Port Profile was implemented to simulate serial communication interfaces using our Bluetooth antennae. This simulation works by sending bursts of data wirelessly between a transmission point and a receiving point.
- I²C is the serial protocol for two-wire interfaces. This protocol that is used for the wired connections in our sensor bundles. This protocol is low powered and only needs two wires to operate, a serial clock (SCL) and serial data (SDA).

Figure 1) Example of Master and slave wireless sensor network using BLE

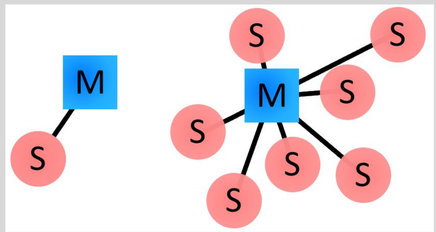
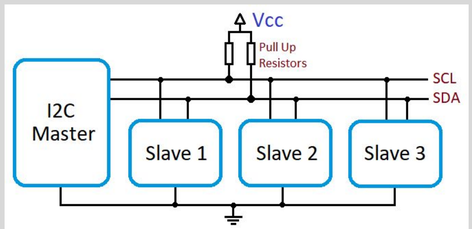


Figure 2) Example of Master and slave sensor network using I²C



Future Improvements

- More sensors pre-programmed for immediate use to increase modularity of device
- WiFi capability to further improve the transmission of data over longer distances
- Cellular communication methods to allow for a communications in more unstable environments and allow redundancy for wireless connections.
- Implement a emergency contact system with the cellular network, to be used for specific project applications.
- A web interface with a server backend to allow for remote data processing.
- Create a single printed circuit board design to create a wearable or similar small scale device using the design concept we researched.

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