

## Assignment #7

Team 11

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Our team, team 11, build the circuit to connect both 3D Accelerometer and PPG sensor to ESP board for collecting data of directions, Heart Rate, Respiration, and SPO2 from several activities such as sleeping, sitting, standing, and walking for 10 minutes.

Through the last assignment, we got a lot of noise when we calculated SPO2. We found that our program run slow. In fact, it might run 50Hz per a minute, but our program run approximately 25Hz per a minute. We try to improve the accuracy of the sensor's value in several ways.

For improving the speed up, we change the amount of sending file size in php.ini. At .htaccess in php.ini, we increase POST size and Upload file size. Also, we increase Apache and PHP timeout values.

Furthermore, we change the sample rate from 50Hz to 100Hz for reducing noise.

The third way to increase the speed is that we used JSON for sending the data of the sensor in the last assignment. We thought that it might be the reason to make the program work slow. So, we used file system object, which is SPIFFS, to store the data in a file. And then we read the file for sending the data to the server. It did not improve the speed of the program, so we stored the data in a CSV file. However, either using JSON or storing CSV file was not a solution for increase sending speed because it showed 10ms faster than before. Therefore, we store the sensing data in a binary file and send it to the server. <sup>1</sup>At hw7.php, we solve the problem as similar as main.cpp. Instead of reading the CSV file and storing the data at mysql, we store the data at memory on the fly and send it to the server directly. It enhances the program fast. <sup>2</sup>

Moreover, when we gather the data such as IR, RED, X, Y, and Z, we use 4 bytes per each data. <sup>3</sup>We send the 37500 bytes data once to server gathering total 20 bytes data such that 5 kinds of data sized 4 bytes during 2 minutes and 30 seconds. We get 1500ms latency for 2 minutes and 30 seconds to write at SPIFFS, spend 3100ms to sending data to server, and spend 700ms to preparing SPIFFS which is formatting again. Thus, total latency is 5.3 seconds per 150 seconds. (2 minutes and 30 seconds) It holds 3.5% of total time of the program.

In this assignment, we store and send data from the combinations of two sensors. Then, we make the CSV file in the format of IR, RED, X, Y, Z, Heart Rate, Respiration Rate, SPO2, activity classifier error rate. Lastly, we plot Heart Rate, Respiration Rate, and SPO2. After getting CSV input file, we calculate the heart rate, respiration rate, and SPO2 by filtering the data through Bandpass filter. Then, we plot those heart rate, respiration rate, and SPO2 like the chart below.

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<sup>1</sup> [https://github.com/kyungwoh/CS244Fall2017/blob/cs244\\_master/Assignment%237/main.cpp#L55-L81](https://github.com/kyungwoh/CS244Fall2017/blob/cs244_master/Assignment%237/main.cpp#L55-L81)

<sup>2</sup> [https://github.com/kyungwoh/CS244Fall2017/blob/cs244\\_master/Assignment%237/hw7\\_csv.php#13](https://github.com/kyungwoh/CS244Fall2017/blob/cs244_master/Assignment%237/hw7_csv.php#13)

<sup>3</sup> [https://github.com/kyungwoh/CS244Fall2017/blob/cs244\\_master/Assignment%237/main.cpp#L135-L160](https://github.com/kyungwoh/CS244Fall2017/blob/cs244_master/Assignment%237/main.cpp#L135-L160)



After plotting Heart Rate, Respiration Rate, and SPO2, we make the window size to make features and extract trained, compact classifier, and extract the test indices by Heart Rate, Respiration Rate, and SPO2, to train the model. Finally, when we classify the activity during training the model, we calculate the classifier error rate. The classifier error rate is 14.8%.