Part C: Activity Monitor Performance Comparison

Group 10
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In this part, we contrast the performance of the two designs: BLE activity monitor (Part A) and cloud activity monitor (Part B). What we aim to measure is the total time consumed by the interval from when the ESP32 receives the sensor readings until the activity is classified as a step or a jump.

In Part A, where everything is done locally on the ESP32 board, the classification time is fast and consistent. We employed the millis() function to record the time elapsed between sensor data reading and activity detection. The average time we recorded for both step and jump classification was approximately 123 milliseconds. This includes reading the accelerometer via I2C, computing the magnitude, performing the classification logic, and printing the result. Since all this is processed on the same device, there is no off-device processing or communication latency.

In Part B, the setup is more complex. The ESP32 is reading sensor data but instead of processing it locally, it sends raw values to a cloud server via an HTTP POST request. The server on AWS gets the data, calculates the magnitude, determines the activity type, and returns the result. To verify the total delay in this design, we measured both the transmission time and the end-to-end detection time. Transmission time refers to the time required for the HTTP POST request from the ESP32 to the server and back. End-to-end detection time refers to the time required from the sensor value reading at the ESP32 until the receipt of the classification message from the server.

Based on the experiments conducted, a step's average end-to-end detection time was 329-698 milliseconds and that of a jump was 328-583 milliseconds. All these include sensor reading time, network latency, and server calculation time. This approach allows data to be centrally and scalably processed but results in additional latency due to remote computation and wireless communication.

Overall, the BLE-based monitor is quicker and more reliable when it comes to detection time because of its bypassing of network latency. The cloud-based monitor, meanwhile, provides a more scalable solution to remote data analysis and storage. Either technique relies on whether low latency and offline computation is preferable, or centralized access and extensibility are needed.