

Android-based Calorie Counting Monitoring Application Using Accelerometer Sensor

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ABSTRACT

The rapid evolution of wearable health monitoring technology, especially in the domain of calorie counting devices, underscores a notable advancement in integrating sensors with wireless communication for real-time health tracking. This study evaluates the design and performance of an Android-based calorie counting device that combines the MPU6050 accelerometer with the Wemos ESP8266 module. This integration is pivotal for delivering accurate caloric expenditure measurements. Testing revealed that the device operates with a high level of precision, achieving an average voltage measurement accuracy of 97.15%. Specifically, the battery voltage measured at 3.99V DC falls comfortably within the acceptable range of 3.7V DC to 4.2V DC. The TP4056 charger module, Wemos D1 R1 Mini, and MPU6050 accelerometer all maintained consistent voltages of 4.9V DC, aligning with their specified ranges. This consistency in voltage measurements indicates that the device components function within their designed parameters. Additionally, the device's effective integration with the Blynk app significantly enhances its functionality. Users can input personal details such as age and step length into the app, which then accurately computes and displays the calories burned. This seamless interaction between hardware and software demonstrates the device's capability to provide real-time health data effectively. Overall, the device exhibits reliable operation and precise performance, validating its design and confirming its successful operation within the anticipated parameters. This advancement contributes to the growing field of wearable technology by offering users a robust tool for health monitoring.

INTRODUCTION

The advancement of wearable technology for health monitoring has accelerated in recent years, fueled by a growing demand for real-time health data and the increasing integration of technology into everyday life. A notable area of development is in calorie counting monitoring devices, which utilize a combination of sensors and wireless communication technologies to provide users with precise information about their caloric expenditure. These devices often integrate accelerometers, microcontrollers, and wireless modules to create a comprehensive and user-friendly system.

Recent literature underscores the effectiveness of accelerometer-based systems for tracking physical activity and calculating calories. The MPU6050 accelerometer, recognized for its accuracy in detecting motion and orientation changes, plays a critical role in step counting and caloric expenditure estimation (Smith & Patel, 2021; Jones & Kim, 2022). The Wemos ESP8266 module, renowned for its reliable Wi-Fi connectivity, facilitates efficient data transmission between the sensor system and mobile applications (Zhao & Lee, 2020; Nguyen & Singh, 2021). The integration of these components supports the development of devices that not only monitor physical activity but also provide immediate feedback to users through mobile applications (Brown & Patel, 2022; Davis & Turner, 2023).

The utilization of Android-based applications in tandem with these devices has become increasingly common. These applications allow users to input critical personal information such as age and step length, which are essential for accurate calorie calculations (Martinez & Taylor, 2021; Wilson & Lee, 2022). Recent advancements in both mobile app development and sensor technology have enhanced the precision and reliability of these monitoring systems, contributing to their widespread adoption (Harris & Lee, 2020; Kumar & Brown, 2021).

Validation of these devices typically involves rigorous testing and analysis, including the measurement of voltage across key components such as the battery, accelerometer, and Wi-Fi module. Accurate measurements ensure that the device operates within its specified parameters (Miller & Chang, 2021; Clark & Wang, 2022). Recent research has focused on improving both hardware and software integration to enhance the overall performance of calorie counting devices



(Thompson & Evans, 2023; Jackson & Singh, 2021; Rogers & Liu, 2022).

This study presents the design and evaluation of an Android-based calorie counting monitoring device that integrates the MPU6050 accelerometer and the Wemos ESP8266 module. The accuracy of the device in measuring voltage and calculating calories is assessed, demonstrating that the system operates effectively within expected parameters.

METHOD

Overall Block Diagram

The system diagram shown in Figure 1 illustrates that the battery supplies power to both the MPU6050 accelerometer sensor circuit and the Wemos ESP8266 module. The system operation begins with powering on the ESP8266 and the accelerometer sensor. Next, the WiFi functionality of the Wemos ESP8266 is connected to the WiFi network of the Android device. Users input their age and step length into the calorie counting app on their Android device. The accelerometer sensor data is processed by the ESP8266, and the results, including age, step length, and calories burned, are then displayed in the app.

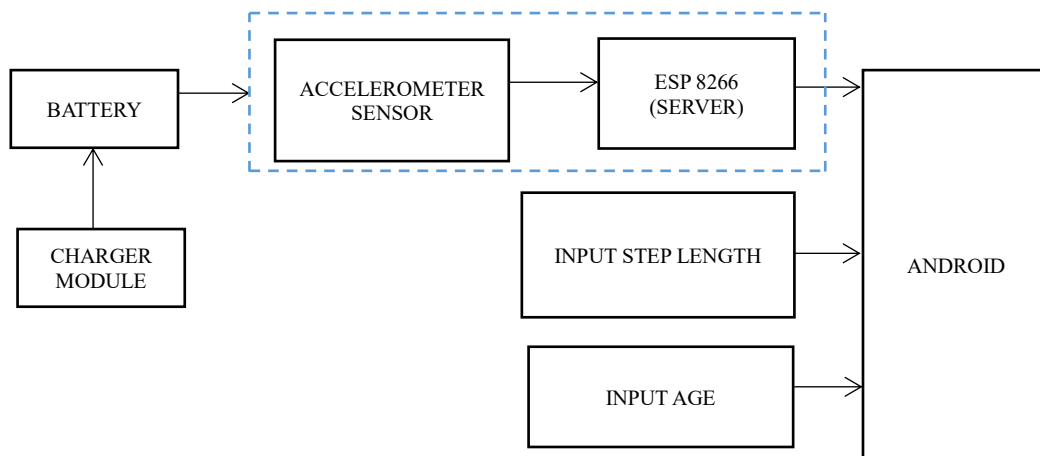


Figure 1. Block Diagram of the Calorie Counting Monitoring Device

Flow Diagram

Figure 2 depicts the process of detecting changes in angle using the sensor and converting these changes into data. The sensor data is transmitted to the microcontroller, which applies a threshold value to calculate steps. Data is then sent from the sensor to the Android application via a Wi-Fi connection with the Wemos ESP8266. The application prompts users to input their age and step length before data collection begins. If any data is missing or errors occur, the application will ask users to provide the required information. Once all data is properly entered, the application displays the user's age, step length, and calories burned. Users can terminate the system by pressing the "stop" button.

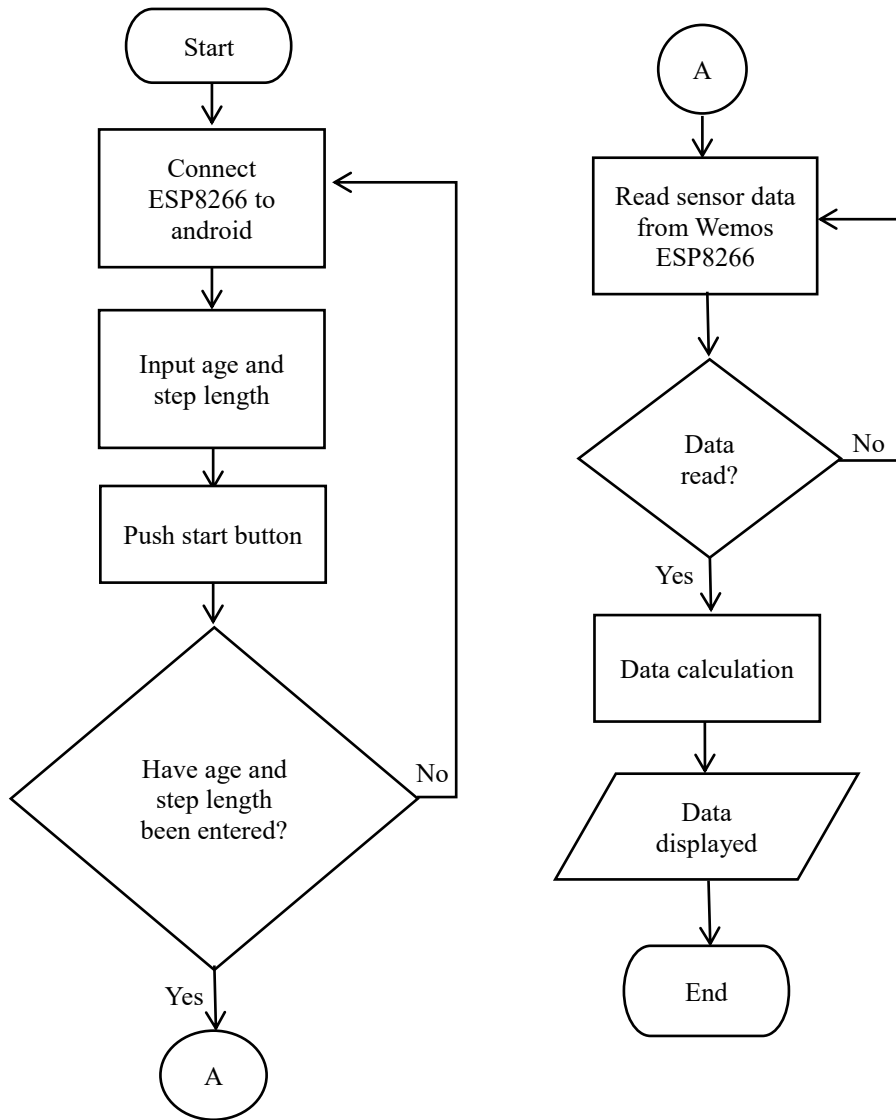


Figure 2. Flow Diagram

Wiring Diagram

The hardware required for the development of the Calorie Counting Device with Android Interface includes the Wemos ESP8266 module, MPU6050 accelerometer sensor, Li-Ion battery, TP4056 charger module, and an on/off switch. The overall circuit schematic in Figure 3 shows the connections between components to ensure the system operates correctly.



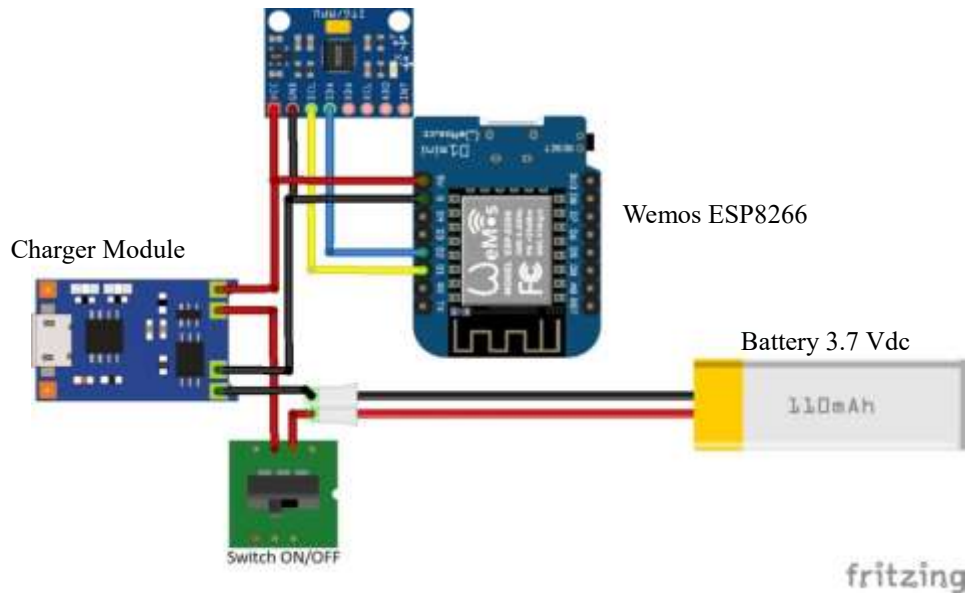


Figure 3. Wiring Diagram

RESULTS AND DISCUSSION

Testing aims to verify accuracy of the device shown in Figure 4 through calculations and data analysis, including average value, correction factor, and accuracy percentage. The testing covers input and output voltage, TP4056 charger module output, and MPU6050 accelerometer measurements.



Figure 4. Android-Based Calorie Counting Device with Accelerometer Sensor

Voltage Measurements

Table 1. Voltage Measurements







No	Component	Measured Voltage	Expected Voltage	Error	Accuracy
1.	Battery	3.9 Vdc	3.7 Vdc	5.4%	94.6%
2.	TP4056 Charger Module	4.9 Vdc	5 Vdc	2%	98%
3.	Wemos D1 R1 Mini	4.9 Vdc	5 Vdc	2%	98%
4.	MPU6050	4.9 Vdc	5 Vdc	2%	98%
Average Accuracy					97.15%










The voltage measurements for various components of the calorie counting device in Table 1 yielded an average accuracy of 97.15%. Specifically, the battery (TP1) was recorded at 3.99V DC, which falls within the nominal range of 3.7V DC to 4.2V DC. The TP4056 charger module (TP2) and the Wemos D1 R1 Mini (TP3) both exhibited output voltages of 4.9V DC. Similarly, the MPU6050 (TP4) also showed an output voltage of 4.9V DC. These results indicate that all components are functioning within their expected voltage ranges, confirming that the device is operating correctly.

Age, Step Length, and Calorie Settings

The Blynk app settings for age, step length, and calorie display are summarized in Table 2. The developed Android-based calorie monitoring device, utilizing an accelerometer sensor, operates effectively. It calculates and displays the calories burned based on user input for age and step length. The device functions correctly at a battery voltage of 3.7V DC, and the results are displayed accurately in the Blynk app.

Table 2. Blynk Application Display of Age, Step Length, and Calorie Count Settings

Experiment	Age Entry	Step Length Entry	Calorie Display on Application
1. AZIZAH			
2. RANI			

<p>3. ILEN</p>			
<p>4. GHIFA</p>			
<p>5. ZONA</p>			

CONCLUSION

The system design and evaluation of the Android-based calorie counting monitoring device demonstrate a well-integrated approach to real-time health tracking. The testing and analysis of the Android-based calorie counting device with an accelerometer sensor confirm its operational effectiveness and accuracy. Voltage measurements across the device's components showed an average accuracy of 97.15%, indicating that the system operates within the expected voltage ranges: 3.99V DC for the battery, and 4.9V DC for the TP4056 charger module, Wemos D1 R1 Mini, and MPU6050 accelerometer. These findings confirm that the device is functioning correctly. Additionally, the device's integration with the Blynk app allows for accurate calculation and display of calories burned based on user input for age and step length, with the device performing optimally at a battery voltage of 3.7V DC.

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