

ECEN-5833

Low Power Embedded Design
Techniques

Project Proposal

*Fitness Performance Tracking
Vest*

Team A.V.D

Aneesh Deshpande, Vaishnavi Patekar, Devang Boradhara

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Performance Tracker

We'll be designing and developing a GPS performance tracker which will measure important performance stats for most sports activities. From a demanding scenic trek to any high intense sports game and provide you an insight of your performance.

It will include the following statistics:

- Current Heart Rate
- Maximum Heart Rate
- Blood Oxygen
- Total Distance
- Altitude, Acceleration
- Max Speed
- No. of Laps/Sprints
- Calories.

Why this?

Performance tracking devices provide a level of individual performance analysis that far surpasses anything coaches and athletes from previous generations were familiar with. The advantages to early adopters of this technology are enormous. Individuals can keep a track of their fitness and get an in-depth understanding of strengths and weaknesses. This knowledge, put together with the right training can do wonders.

Managing Workload

For emerging athletes, consistent and intelligent training is crucial for long-term success, particularly for those aspiring to college-level sports and beyond. Field sports like soccer, football, and baseball demand skill development through year-round, focused training. However, overtraining poses risks to athletes and teams. With performance tracking technology, coaches can now make data-driven decisions to balance intensity and rest, ensuring peak performance on game days.

Injury Reduction

Injuries are a significant concern for athletes and teams, especially when they result from preventable factors, such as risky training practices. Performance tracking offers valuable insights into determining suitable training thresholds, preventing overexertion, and managing fatigue and stress during games and practices.

Block Diagram

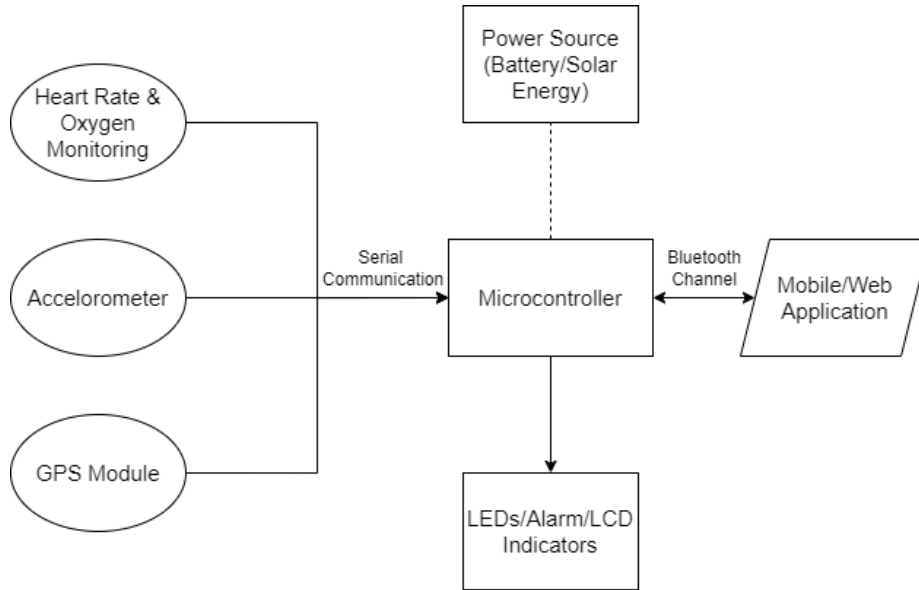


Figure 1: High Level Block Diagram

Microprocessor and Sensor Selection

EFR32 Blue Gecko

The EFR32 Blue Gecko is a ARM Cortex-M4 based family of wireless system-on-chip (SoC) devices used as an energy-efficient solution for wireless communication and IoT applications.

Operating Parameters	Range
Power Supply Voltage	1.8V – 3.8V
Wireless Connectivity	Bluetooth Low Energy (BLE), Zigbee, Thread
Peripherals	GPIO pins, UARTs, SPI, I2C, timers, and analog interfaces
Power Modes	active, sleep, deep sleep, and hibernate, (EM0 – EM3)
Operating Temperature Range	-40°C to +85°C

Heart Rate & Pulse Oximeter Sensor, MAX30102

The MAX30102 is used to measure both heart rate and oxygen saturation (SpO₂). It works by emitting and detecting infrared light through the skin, measuring variations in light absorption due to blood flow, and using this information to calculate heart rate and SpO₂ levels in wearable fitness devices. It plays a crucial role in monitoring the wearer's health and fitness parameters in real-time.

Operating Parameters	Range
Power Supply Voltage	3.3V – 5V
Communication Interface	I2C
Capability of heart rate measurement	30BPM – 200BPM
Oxygen Saturation Measurement	70% - 100%
Sampling Rate	50Hz – 1KHz
Operating Temperature Range	-40°C to +85°C

Accelerometer, LIS3DH Triple-Axis

The LIS3DH is a triple-axis accelerometer sensor used for motion sensing. Here are the working requirements and specifications of the LIS3DH Triple-Axis module:

Operating Parameters	Range
Power Supply Voltage	1.71V – 3.6V
Communication Interface	I2C/SPI
Measurement Axes	Three orthogonal axes: X, Y, and Z
Acceleration Range	70% - 100%
Operating Temperature Range	-40°C to +85°C

GPS Module, GPS NEO-6M

The GPS NEO-6M module is used for obtaining accurate location and time information. Here are the working requirements and specifications of the NEO-6M GPS module:

Operating Parameters	Range
Power Supply Voltage	3.3V – 5V
Communication Interface	UART
Operating Temperature Range	-40°C to +85°C

Product Features

- Free and easy to use Vest Mobile Application which enables the user to track the cardinal parameters related to human body (heartbeat rate and blood oxygen levels) and movement (speed, altitude, location) while performing any physical activity.
- Load power management would be implemented through software based on sensory data, such that, components consume as low power as possible.
- The device can run on rechargeable batteries, and it would also support charging over solar energy as a part of energy harvesting.
- If threshold values of heartbeat or oxygen levels are crossed above or below limits, the mobile app will support notifying the user with a warning.

References

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