Personal Tracker - Requirements with Recommended Components

Project Overview

Design a compact, battery-powered tracking device for outdoor and indoor athletic performance monitoring. The device must support precise positioning, motion tracking, real-time data transmission, and onboard logging.

Power & Charging System

- Battery: 3.7V 1000 mAh LiPo
- Charging via USB-C (5V input)
- Wireless charging: Qi-compatible receiver module
- Charging IC: TP4056
- Battery protection: DW01A + FS8205A or equivalent
- Voltage regulation: ME6211 or AMS1117-3.3 (3.3V LDO)
- Physical power on/off switch

Core Components

- Microcontroller: ESP32-WROOM-32 (Wi-Fi + BLE + dual-core MCU)
- GNSS Module: u-blox NEO-M9N (multi-band, RTK capable)
- Cellular Module: SIM7000G (LTE-M, NB-IoT, 2G fallback, GNSS support)
- IMU: MPU9250 or ICM-20948 (9DOF: accelerometer, gyroscope, magnetometer)
- UWB: Optional header for DWM1001 or DW3000 (for indoor positioning)

Interfaces & Peripherals

- microSD card (SPI interface, placed on PCB back side)
- USB-C: for charging, debugging, and data access
- UART: for SIM7000G and USB debug console
- SPI: shared between IMU and microSD

- I2C (optional): reserved for future expansion

- GPIO: status LED, power control

Antenna Connections

- GNSS: External antenna via U.FL (NEO-M9N)

- LTE: External antenna via U.FL (SIM7000G)

- Wi-Fi/BLE: Internal PCB trace or optional U.FL

Firmware Features

- GNSS + IMU sensor fusion for high-accuracy tracking

- RTK correction over LTE (e.g., NTRIP or mobile base)

- 10 Hz real-time telemetry (GPS, speed, acceleration, sprints)

- 2s summary updates (distance, top speed, etc.)

- MQTT communication over Wi-Fi or LTE

- Data logging to microSD card

- USB access for file download

PCB Design & Production

- Board size: ~45 × 30 mm (rounded rectangle)

- 2-layer PCB, Eurocircuits compatible

- Double-sided component placement

- Stencil-ready paste layer and DFM-compliant layout

Output Files

- KiCad project files (.kicad_sch, .kicad_pcb, etc.)

- Gerbers and drill files

- Bill of Materials (BOM) with part numbers

- Pick and Place file (CPL)

- Assembly drawings and paste stencil

- Full project archive (.zip)