Development of Cost-Effective Wearable Sensors for Monitoring Athletes' Performance in Nigeria

Proposal Submitted to National Agency for Science and Engineering Infrastructure (NASENI)

2025

1. Executive Summary

This proposal seeks funding from the National Agency for Science and Engineering Infrastructure (NASENI) to design, develop, and validate cost-effective wearable sensors for athlete performance monitoring in Nigeria. The project addresses a critical gap, as imported wearable devices are exorbitantly expensive and inaccessible to most local sports clubs and academies. The project will leverage indigenous expertise in sports science and engineering to produce affordable, functional prototypes tailored to the needs of Nigerian athletes. Expected outcomes include the design of locally manufactured wearable sensors, validation against international standards, and the creation of a commercialisation pathway through collaboration with Nigerian SMEs. This project aligns with NASENI's mandate to foster indigenous technology, reduce foreign dependency, and promote industrialisation.

2. Background and Problem Statement

Performance monitoring has become a vital part of modern sports science. It has proven to be essential for optimizing training, preventing injuries, as well as increasing athlete longevity across various sports and competitions (Exel & Dabnichki, 2024). Wearable technologies are widely used worldwide for tracking and assessing athlete performance. However, Nigerian athletes and clubs encounter obstacles in accessing these innovations due to the high costs of imported wearable devices. Equipment such as GPS trackers, accelerometers, and biometric monitors are often unaffordable for grassroots and semi-professional teams. This creates a technological gap, hindering Nigeria's ability to compete globally.

Developing affordable indigenous wearable sensors presents a practical solution. By merging expertise in sports science with engineering design and local manufacturing, Nigeria can lessen dependence on overseas imports, foster industrial self-reliance, and make athlete performance technologies more accessible. This initiative supports NASENI's goal of promoting home-grown innovations in engineering infrastructure.

3. Technology Readiness

As a pilot study, we have previously developed a prototype of inertial measurement units (IMU). The prototype was used to measure trick performance in the skateboarding sport. In the technology, the IMU device was modelled and instrumented via CATIA software as depicted in Figures 1 and 2. A Zortax M200 Plus 3D printer was employed to build a suitable casing for the device to such an extent that it does not restrain the movement of the skateboard throughout the tricks' performance. It is worth noting that the device has shown excellent reliability in evaluating skateboarding-related manoeuvres (Ab Rasid et al., 2025).

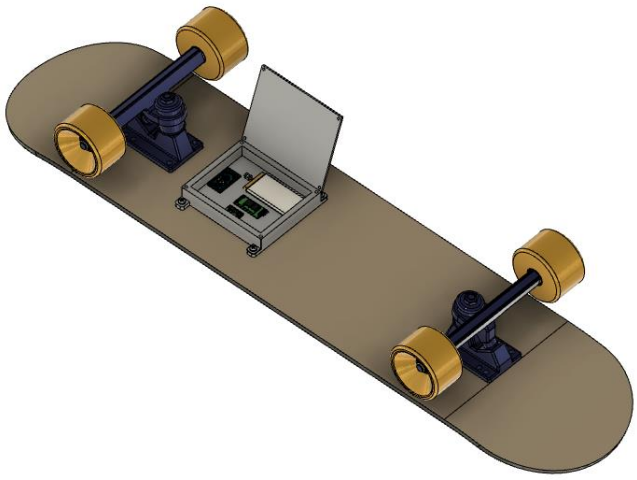

Figure 1: ORY skateboard with customized IMU instrumentation

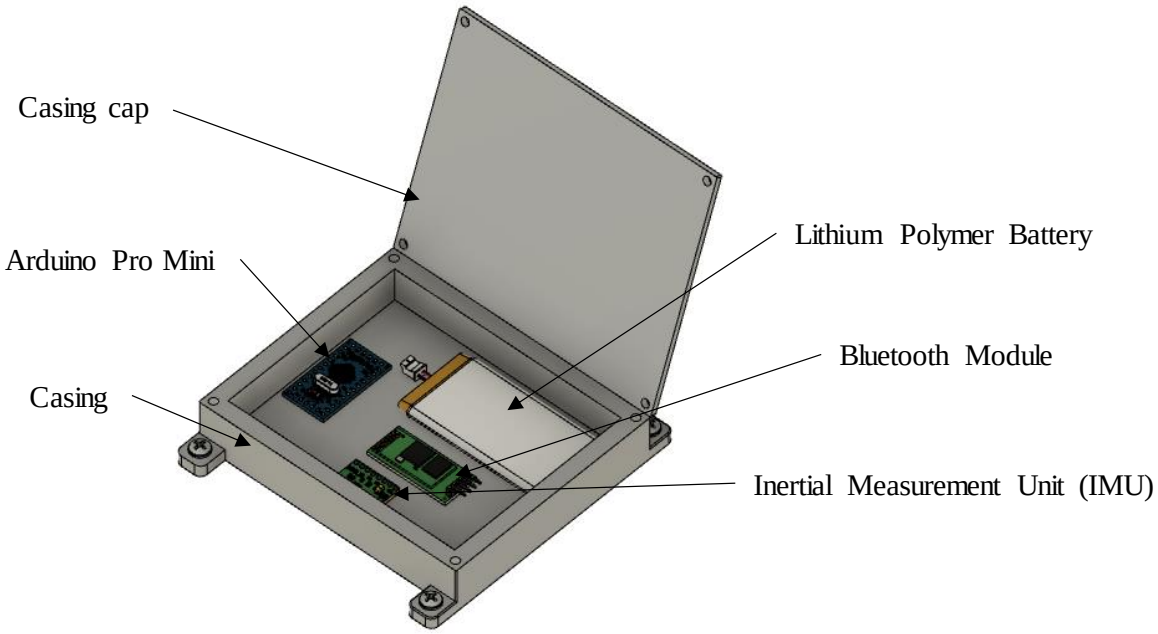

Figure 2: Instrumentation of the prototype IMU device

We aim to build on this existing technology by enhancing its casing to expand to different sports and games capable of quantifying and evaluating different athletes' metrics, such as external load, running profiles as well as several work-related loads inherent to any sports.

4. Project Objectives

The key objectives of the project are:

1. To design and prototype cost-effective wearable sensors for monitoring athletic performance.
2. To validate the accuracy of the sensors against established international devices.
3. To ensure affordability by utilising local materials and simplified production designs.
4. To establish a commercialisation pathway through partnerships with Nigerian SMEs.

5. Methodology and Work Plan

The project will be conducted in four phases:

• Phase 1: Needs Assessment and Design – Identify essential athlete performance metrics (workload, movement, exertion) and design sensor architecture.

• Phase 2: Prototype Development – Collaborate with engineers to develop hardware (microcontrollers, Bluetooth modules) and software applications.

• Phase 3: Testing and Validation – Conduct trials with athletes, comparing performance data to commercial devices.

• Phase 4: Refinement and Scalability – Optimise cost, durability, and prepare for local manufacturing.

Figure 3 illustrates the 18-month implementation timeline for the current proposed project

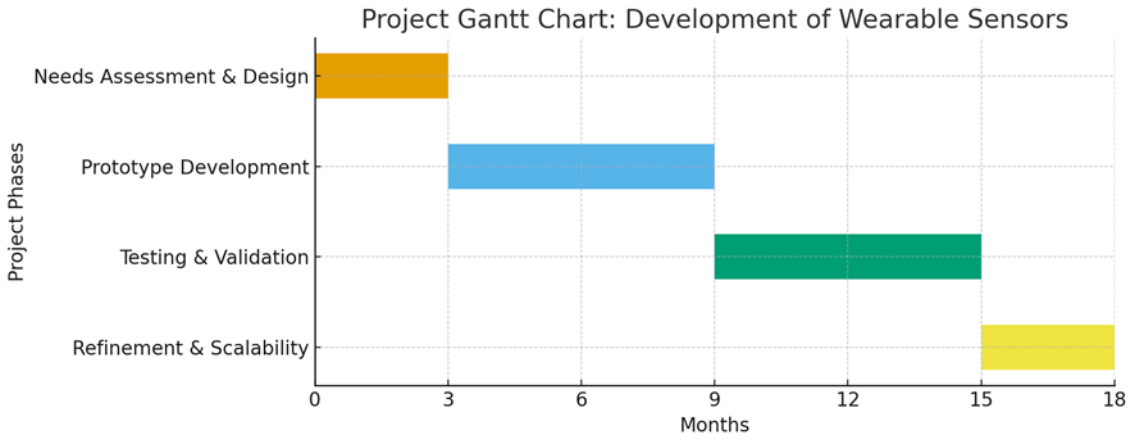

Figure 3: Gantt Chart (Project Timeline)

6. Expected Outputs and Outcomes

- Functional prototypes of wearable sensors.
- Validation data demonstrating performance reliability.
- Partnerships with local SMEs for scaling production.
- Dissemination of results to Nigerian sports federations and policymakers.
- Increased access to athlete monitoring technologies in grassroots and professional sports.

7. Project Management and Implementation

Dr. Rabiu Muazu Musa, a sports scientist with expertise in performance monitoring and data analytics, will lead the project. The interdisciplinary team will include engineers (hardware and software), sports club partners for pilot testing, and SME partners for local production. A project steering committee will ensure compliance with NASENI's reporting requirements. Table 1 tabulates the full information of the research teams involved in the proposed project.

Name	Address/Affiliation	Area of Expertise
Dr. Rabiu Muazu Musa Project Leader	Universiti Malaysia Terengganu.	Talent Identification Sports Monitoring & Evaluation
Engr. Dr. Muhammad Bashir Ibrahim	TWI Ltd/21 Dan Sulaiman Street, Utako Abuja	Project Management Digital Transformation & Innovations/Talent Ambassador
Dr. Muhammad Amirul Abdullah	Universiti Malaysia Pahang Al-Sultan Abdullah	Software Development Computer Vision Sports Biomechanics
Associate Prof. Dr. Anwar P.P. Abdul Majeed	Sunway University Malaysia	Machine Learning in Sports Robotics
Associate Prof. Dr. Mohamad Razali Abdullah	Universiti Sultan Zainal Abidin, Malaysia	Fitness and Evaluation Sports Biomechanics

8. Budget and Justification

The breakdown for the proposed budget is provided as follows:

Equipment & Specification	Budgeted Amount (₦)
Hardware components (sensors, microcontrollers, PCB design)	₦8,000,000
Software development and cloud integration	₦5,000,000
Prototype testing and validation (athlete trials)	₦4,000,000
Personnel and research assistants	₦6,000,000
Dissemination and training workshops	₦2,000,000
Grand Total	₦25,000,000

Each cost directly supports project outcomes and is justified by the need to achieve reliable prototypes, rigorous validation, and pathways to commercialisation.

9. Sustainability and Impact

The project is designed for sustainability beyond the grant period. By involving SMEs from the outset, commercialisation and mass production will be achievable. This initiative will foster technology transfer, create jobs, and build capacity among young Nigerian engineers and sports scientists. The wider impact includes improving grassroots sports development, strengthening Nigeria's competitiveness internationally, and contributing to the national industrialisation agenda.

10. Monitoring and Evaluation

The project will employ clear KPIs to measure progress, including:

- Completion of prototypes within 6 months.
- Validation studies against at least two commercial devices.
- Partnership agreements with at least two SMEs.
- Pilot adoption by at least two sports clubs.

Quarterly progress reports will be submitted to NASENI, with a final comprehensive evaluation at project conclusion.

References

Ab Rasid, A. M., Musa, A., Abdullah, M. A., Abdul Majeed, A. P., Mohd Razmaan, M. A., Abdullah, M. R., ... & Musa, R. M. (2025). Test-retest reliability of customised inertial measurement units (IMUs) in evaluating skateboarding related manoeuvres. *Proceedings of the Institution of Mechanical Engineers, Part P: Journal of Sports Engineering and Technology*, *239*(2), 179-187.

Exel, J., & Dabnichki, P. (2024). Precision sports science: what is next for data analytics for athlete performance and well-being optimization?. *Applied Sciences*, *14*(8), 3361.