

SPORSA - Innovative Technology for Safer Cycling

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Abstract

Race cycling has a serious problem. There are too many crashes, too many communication issues, and there is too much chaos. Cycling, both professional and amateur, needs technology to make its races safer and to communicate faster and more efficiently with and about its riders. The SPORSA sensor and associated intelligent dashboard provides an answer to these problems and monitors the dynamics in the peloton during the race. The sensor consists of an IMU to detect the type of event, a GPS module for the location/tracking, a device scanner to know which other riders are nearby and to back-up the GPS, a connectivity module for communication and an LED array to visualize high-risk segments to the riders. The mobile live dashboard automatically generates and communicates waymarkers based on the real-time event and location data.

Keywords

cycling; safety; hardware; real-time; incident detection; mapping; judging; tracking

1 Introduction

Race cycling safety is a hot topic in the news today. Too many crashes during the past season have opened discussion again on the need for change. In this discussion, the growing consensus is that technological solutions are essential in this change. Extra rules and subjective judging - the traditional way on how federations have tried to solve the

safety problem in the last decade - haven't made much difference in the past decade, as also shown by the injury statistics of ProCyclingStats [1] (Figure 1).

To fully understand the problem, we extensively consulted all stakeholders (teams/riders, federations, journalists, fans and family, race doctors, and organizers). Based on their input, we have defined 4 high priority



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needs SPORSA - the proposed safety sensor - is focusing on:

- Providing continuous safety insights and peloton/group dynamics.
- Publish accurate live data at all racing levels about who is where.
- Develop data-informed, objective judging methodologies.
- Create personalized/detailed race analysis reports for riders/teams.

By solving these needs, SPORSA will make cycling safer, fairer, and more accessible/informed.

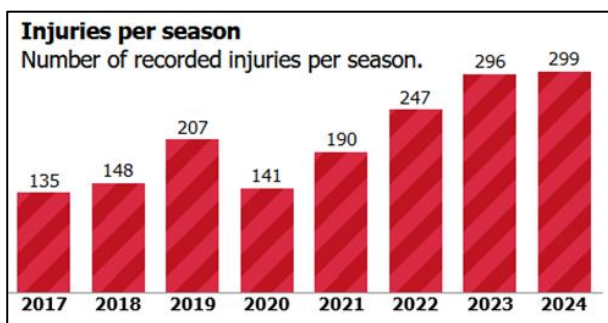


Figure 1. PCS stats on injuries per season [1]

2 Material and Methods

Based on the collected information from the different stakeholders, a first functional and technical analysis was performed, resulting in a v1 of the hardware and design requirements of the SPORSA device. The proposed set-up, shown below, consists of an accelerometer, GPS module, device scanner, connectivity and an LED array (Figure 2).

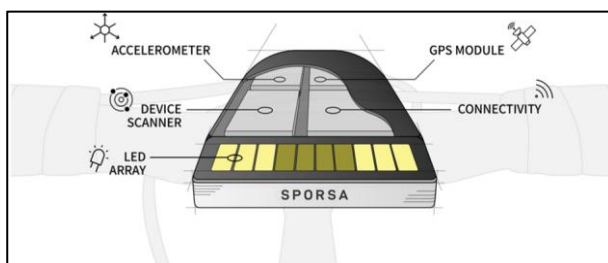


Figure 2. SPORSA hardware set-up

Next to the hardware, the dashboard methodology for communication with the different stakeholders is also defined. An interactive map (Figure 3) will be used as a

central platform to communicate with all stakeholders. It is currently being implemented as a SPORSA layer on top of VeloViewer. Safety-related Points of Interest (POIs) can be placed on the map before and live during the race, all in a fully-automatic way, as will be shown in our demo on the Science & Cycling conference.



Figure 3. SPORSA interactive safety dashboard showing safety POIs and detected incidents

POIs will be communicated to the riders when they are near them using a location based proximity detection algorithm running on the device itself. If a rider falls or a near-miss incident is detected, this will also be visualized on the map. Race doctors and road marshals can label crash POIs so that everyone can quickly understand the severity, but also the live tracking data can already tell us a lot about the severity, e.g., is he/she still riding/moving. As output for organizers, the map can also show the risky zones on the course as a heatmap.

3 Discussion

Existing 'safety monitoring' solutions, such as the alarm functions provided by Garmin and Strava, solely focus on the individual and do not take into account context and impact on other riders. Most of these systems also require a smartphone connected to it, which makes it the responsibility of the user to connect and share his data. Furthermore, none of these solutions focus on near-incident insights - a key feature which organizers & federations brought up during our stakeholder consult and SPORSA is focusing on too.

Safety and incident communication to/from riders and race convoy, which is currently done using portable radio is also too slow, not standardized, sensitive to crashes (i.e., clothing and device get damaged), and lacking crucial information (as mentioned by organizers, race doctors and teams). “All riders should get the same safety info at the same time” is something we heard multiple times from our stakeholders. SPORSA communication will be more consistent and faster!

In other sports, like sailing and triathlon, location trackers (like Tracrac [2], Georacing [3] and McIlroyd [4]), are implemented with success. In cycling, however, the location of many athletes is very often still unknown or only known at some fixed positions when measured with, e.g., MyLaps timing technology. At the highest level of cycling, NTT Data/Insiders and Velon track riders collect all their sensor data, but mainly with a focus on storytelling, not on safety. Their solutions also seem not scalable to lower levels (due to their high cost) and they are limited to one-way communication and only solve one of the needs of our stakeholders.

4 Practical Applications

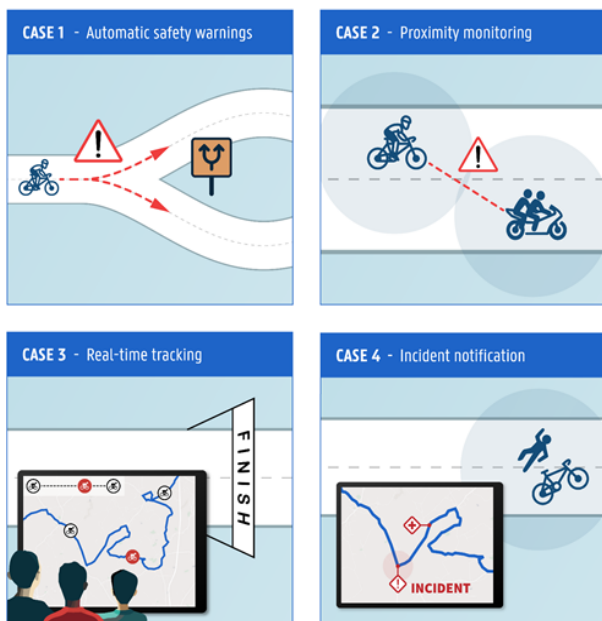


Figure 4. SPORSA stakeholders focused use cases

Based on the stakeholders input we have defined 4 use cases (shown below) which will be tested in summer 2025 in official races in Flanders. Each of them focuses on other stakeholders. The automatic safety warnings show riders high-risk POIs. Proximity monitoring can be used by race commissaires/UCI to monitor irregular behavior of the race convoy. The real-time tracking allows fans & family to follow their riders, and the incident notification improves crash-related communication to race doctors.

5 Conclusions

In order to solve the urgent safety needs and problems race cycling is facing today, we propose a scalable/dynamic solution for in-the-race safety monitoring, rider tracking, objective judging and storytelling. The SPORSA safety sensor will make cycling safer using state-of-the-art technology and hopefully reduce incidents in the future.

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Conflicts of Interest: The authors declare no conflict of interest.

References

1. Pro Cycling Stats - Number of recorded injuries per season (2025). Retrieved from <https://www.procyclingstats.com/statistics/riders/injuries>
2. TracTrac - Leaders in live sports tracking (2025). Retrieved from <https://tracrac.com/>
3. Georacing - Real-time GPS tracking solutions for sports events (2025). Retrieved from <https://www.georacing.com/>
4. McIlroyd - GPS tracking solutions for performance and broadcast (2021). Retrieved from <https://mclloyd.com/en/>
5. MyLaps - Timing for road cycling (2025). Retrieved from <https://mylaps.com/>