

# Low-energy backup communication system for hydrogen racecar

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## Abstract

*The abstract is a brief (50–80 words) synopsis of the paper. Use up to 5 keywords.*

*Geef een beknopte samenvatting van het uitgevoerde onderzoek. Vermeld de conclusies die zijn getrokken en de mogelijke implicaties daarvan.*

*geeft        probleemstelling, Aanpak, methode, Belangrijkste resultaten, Conclusies en implicaties*

**Keywords**—Wireless, Low power, long-range

## I. INTRODUCTION

In a race with hydrogen cars, it is important for the pitwall to maintain communication with the car on track. At the pitwall, there must be continuous monitoring of the car's condition and speech communication with the driver. This is crucial for the course of the race. As a result, a backup communication system is required in case the primary system fails. This paper proposes a low-power, long-range wireless solution capable of transmitting and receiving both sensor data and voice signals. The required range of the system is determined by the size of the Le Mans circuit in France, which is approximately 2 km in diameter. This distance therefore defines the minimum communication range needed.

## II. SYSTEM OVERVIEW

## III. IMPLEMENTATION

## IV. TESTING

## V. CONCLUSION

## VI. FIRMWARE DESIGN AND IMPLEMENTATION

In this section, we present the design and implementation of the firmware for the STM32U5, which enables two-way raw LoRa communication, speech synthesis and voice command recognition.

### A. Firmware Design

[Describe the structure of the firmware. Mention FreeRTOS (if used), key modules/tasks, inter-process communication, power handling, interrupt strategies, etc.]

### B. Testing and Results

[Discuss how you verified the system. Include relevant metrics: timing, memory usage, communication robustness, etc. Optionally describe test setups.]

### C. Conclusion

[Summarize what you built, how well it works, and potential areas for improvement or future work.]

## VII. BACKEND AND GRAPHICAL USER INTERFACE DESIGN AND IMPLEMENTATION

## VIII. HARDWARE DESIGN AND IMPLEMENTATION

## REFERENCES

[1] Author Name, *Title of the Book or Article*, Publisher or Journal, Year.