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REAL-TIME FOREST FIRE MONITORING IN THE GUANACASTE CONSERVATION AREA: A LORA-BASED SENSOR NODE SYSTEM WITH SATELLITE DATA INTEGRATION

Abstract

The Guanacaste Conservation Area, declared as a World Heritage Site by UNESCO in 1999, covers approximately 2% of the country's territory, and is host to 2.6% of the global terrestrial biodiversity, it is also mainly composed of dry forest. Despite recent efforts to recover from the damage caused by logging, poaching and misuse of lands, the forest remains at risk from fires mostly from anthropogenic origin, enhanced by extremely dry weather due to climate change, which require significant effort from park rangers to detect and act on. This research outlines the development of a LoRa-based sensor node system for the detection and prevention of forest fires in the Guanacaste Conservation Area of Costa Rica.

The proposed system to be developed in collaboration with the Universidad de Costa Rica, the Guanacaste Conservation Area and local communities, will aim to detect signals of potential fires through collective detection of sensor nodes, addressing challenges such as scalability, durability, cost-effectiveness and minimizing the environmental impact of the nodes. In order to withstand the extreme conditions of the environment, the system must be equipped with a specialized enclosure that ensures that the gas sensors will get exposed to the ambient air whilst the sensitive parts of the electronics are protected from the environment. Additionally, satellite data is going to be used in order to determine the optimal positioning of the sensor nodes within the conservation area according to fire-prone areas of the forest or proximity to other vulnerable objects. The system intends to establish correlations and detect gasses associated with combustion, minimize the use of potentially harmful materials and elements commonly used in electronics and simplify the installation and operation processes of each node.

The proposed ground sensor node system endeavors to enhance satellite and climatic data, providing a more comprehensive understanding of conditions within the forest. This will aid park rangers improve response times to forest fire events. All while using satellite data to position the sensors optimally.