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Wi-Fi/LoRa communication systems for fire and seismic-risk mitigation and health monitoring

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Abstract-

This article summarizes the work performed by the authors in developing, during the last 2 years, several portable and wireless sensor systems that allowed the analysis of signals collected from multiple sensors based on the Internet of Things (IoT) in emergency contexts. These include fires and earthquakes, situations in which citizens suffer from poor health; participation of individuals in highly physical sports; or cases of materials used in buildings and other structures being subjected to high stress due to natural catastrophes other than the aforementioned fires and earthquakes. Novel material sensors like MXene paper or wallpaper-based ones used as fire detectors and operating remotely via Wi-Fi and LoRa are presented. Furthermore, a Wi-Fi communication system, physically connected to a commercial micro-controller, monitored the temperature and luminosity data. Other devices, such as IoT wireless systems operating under the LoRa protocol in the 868-MHz and 2.4-GHz band region and using RFM95 radio modules as possible risk advisers, are described. For the latter, the sensors integrated were triboelectric energy nanogenerators (TENGs). In addition, TENG smart masks with LoRa emitters were used and played an important role in risk mitigation. As novel systems, an STM32 LoRa board allowed monitoring of the health (heart rate and oxygen saturation) of athletes involved in combat sports, with a nano-IoT Arduino 33 chip being used for monitoring the electrical resistance change in some composite materials. Some of these developments, especially the previously mentioned one, can play an important role in structural health monitoring (SHM) by examining the mechanical properties during service operations in aviation or aerospace fields. A comparison of these systems allowed them to be classified according to the most fitting application.

Index Terms- triboelectric sensors, energy generation, seismic sensors, fire retardancy, IoT, LoRa, wireless communications, risk mitigation

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