Deep learning method to identify fire ignitions

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The SAFe project aims to create and implement a set of innovative operations that minimize the time of forest ignitions identification contributing to the development of the Trás-os-Montes region. Thus, it is intended to locate a set of sensors in the forest, data information will be collected, and the artificial intelligence algorithm Deep Learning will be applied to achieve the intended end. Numerical results demonstrated the approach reliability.

Keywords

Artificial Intelligence. Learning algorithms. Forest Ignitions.

The forest fires are a continuous worldwide problem since a sufficiently effective solution has not yet been found. One of the major problems of this theme in our country is the fact that the Portuguese forest has a very tight vegetation, thus limiting the use of image sensors, which according to [1] are the best option for the detection of forest ignitions. Once this surveillance option is excluded and considering that the first 20 minutes are essential to minimize the damage caused by the fire, innovative approaches must be study and implemented [2].

For that, SAFe project presents a solution that implements a set of innovative operations that minimize the identification time of forest ignitions and contribute to the development of the Trás-os-Montes region. Thus, it is intended to locate a set of sensor modules in the forest, data information will be collected from them, and artificial intelligence algorithms will be applied to send alerts to the surveillance agents.

The prototype of the wireless sensor module is composed by the central element based on a microcontroller which will send the data through a wide area network communication.The nodes, through LoRaWAN, connect to the gateways that send the acquired data to the application server where the processing will be done. The level of data transmission will also be a simpler process as there is no need to transmit images, producing only data in numerical format. The data generated will be in massive quantities since the sensors collect with an interval of two minutes between them [3]. This system will allow to obtain an immediate control thus facilitating the task of processing and later alerting within the time window necessary to minimize the damages caused by the fire. Taking into account the amount of data on a daily basis, it is possible to apply artificial intelligence, more precisely, the method of deep learning. This system will become more intelligent each hour, due to constant training with values of daily values which will consequently result in a more credible system day after day. The prototype of the node will consist of several elements, namely, a microcontroller, through LoRaWAN communication, sends data from five infrared sensors, air temperature and humidityThis type of sensors will be a more economical solution both in terms of money and energy consumption when compared to image sensors [1].

In this work, the data obtained from five infrared sensors were analysed. The Deep learning algorithm was implemented using the predefined MatLab functions and it was used to predict the behaviour of the sensors data. It is possible to verify, in 1, the final alert, combined from the individual alerts of each of the five sensors, identifying the forest ignition.

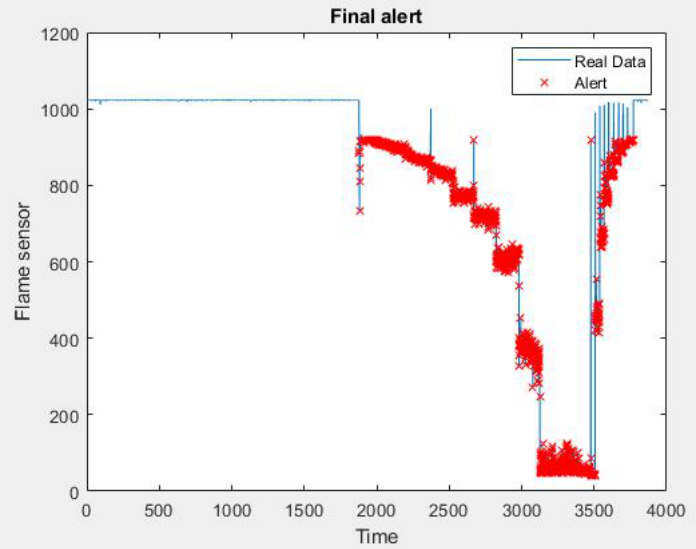

Fig. 1. Alert chart.

Future work will involve the use of more types of sensors and not just flame sensors, in order to combat any false alert given by them. Thus making the software even more reliable.

References

[1] F. Félix and L. Lourenço. O tempo de resposta do ataque inicial a incêndios florestais nos espaços mais sensíveis de Portugal: o exemplo prático da serra da Lousã. *Territorium: Revista Portuguesa de riscos*, 187–211, 2017.

[2] N. Verma and D. Singh. Analysis of cost-effective sensors: Data Fusion approach used for Forest Fire Application. *Materials today: proceedings* **24:** 3584–3588, 2020.

[3] T. Brito, A. Pereira, J. Lima, J. Castro, and A Valente. Optimal Sensors Positioning to Detect Forest Fire Ignitions.*Proceedings of the 9th International Conference on Operations Research and Enterprise Systems - Volume 1: ND2A,* 411–418, 2020.