FyreWatch: Deep Learning for Accurate Wildfire Environmental Conditions Detection

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Wildfires burn over 7 million hectares annually in just the United States alone, with the severity and frequency rising year over year. Although a number of standardized wildfire danger indices exist to detect areas of higher risk based on environmental conditions, the data is evaluated manually and remotely by firefighters, lengthening time to action and contributing to human error. Current data collection methods such as fire towers or drones, are limited by natural conditions like wind and smoke. Satellite remote sensing can overcome these challenges, and represents a viable alternative. This novel study developed binary classification artificial neural networks on remotely sensed satellite data to detect the presence of wildfire environmental conditions in one-hectare regions. These trained models were then integrated into an application for field use by firefighters. A comprehensive dataset of over 2000 cases was constructed from wildfire indices containing commonly used remotely sensed conditions, and was used to develop a novel method of fuel moisture quantification with k-means clustering on Normalized Difference Vegetation Index satellite imagery. The neural network was developed employing optimized hyper-parameters to allow greater model validation and reduce overfit. The trained model was integrated into a field-use application for firefighters which achieved an experimental accuracy of 98%, autonomously classifying 200 real-time preemptive fire cases in a sub-second runtime. This detection capability allows for more geo-precise prevention tactics leading to an expected reduction of ignitions by 46-74%. This can significantly reduce the $4.9 billion spent yearly by US forestry departments on fire suppression and provide important leaps to wildland science.