A Multilayer Perceptron Based Neural Network Model to Identify Optimal Camera Locations for Early Detection of Wildfires

Govindaraju, Sohan (School: Jesuit High School)

In 2024, climate change-induced wildfires burned over 8 million acres across the U.S. and my home state of Oregon faced its most destructive wildfire year on record, with 1.9 million acres scorched and over $320 million spent. These growing threats highlight the need for improved early detection. Wildfire surveillance cameras provide crucial real-time monitoring, but current camera placement is likely suboptimal due to restrictions and accessibility concerns with placement on towers and funding issues. This study develops a multilayer perceptron (MLP) neural network model to predict the effectiveness of camera placement throughout the state using wildfire risk index, local topography, and population density. The model assigns a probability score to each location, indicating its potential suitability for early wildfire detection. Out of 737 total locations, 289 were randomly selected for training and testing. The model achieved 99% accuracy in identifying no-camera sites and 70% accuracy in predicting actual camera placements in the training and testing subsets. An evaluation of 109 existing camera sites in Oregon showed that nearly all were placed in areas with (>0%) probability, with 6.5% of the sites that were in high-probability zones (>90%). The model was then used to assess 628 potential future camera sites statewide. It identified 199 locations with >90% suitability where cameras can be installed now for maximum effect. This model provides a data-driven framework for agencies and lawmakers to optimize camera placement policies and improve wildfire detection capabilities across Oregon. Additionally, mathematical models like this will allow for a high return on investment to maximize resources while minimizing costs to be proactive instead of reactive.

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