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Indian Bushfire Detection Using Machine Learning and Neural Networks

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ABSTRACT
Forest fires are increasingly one of the most predominant and alarming disasters in the planet right now and preventing it is very important in order to protect the environment and thousands of animals and plants species that depend on it. The 2019–20 indian bushfire caused serious uncontrolled fires throughout the summer which burnt millions of hectares of land, destroyed thousands of buildings and killed many people. It has also been estimated to have killed about a billion animals and has bought endangered species on the brink of extinction. Such catastrophic events cannot be allowed to be repeated again. The primary goal of this paper is to improve the efficiency of forest fire detection system of australia. Data mining and machine learning techniques can help to anticipate and quickly detect fires and take immediate action to minimise the damage. In this paper we try to focus on the implementation of a set of well-known classification algorithms (k-nn and artificial neural networks), which can reduce the existing disadvantages of the fire detection systems. Results from the kaggle dataset infer that our ann-mlp algorithm (multilayer perceptron) yields better performance by calculating confusion matrix that in turn helps us to calculate performance measure as detection rate accuracy. All predictions and calculations are done with the help of data collected by lance firms operated by nasa's earth science data and information system (esdis). The training and testing of the model was done using university of maryland dataset and was implemented using python.

Keywords: Environment, Multilayer Perceptron, Efficiency, Detection Rate Accuracy, Machine Learning

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I. Introduction

A wildfire, which is often known as a forest fire, brush fire, or bushfire, is an uncontrolled fire mainly occurring in wildland areas, which is also capable of consuming houses or agricultural lands. Analysing and Identifying the accurate patterns of the causes of these fires is a major problem as physical sensors and fire detectors get damaged in the fires and it is not feasible to place sensors in all the places, therefore the most convenient way of getting the data is through satellite data and imagery because of their relative ease of processing and interpretation. To approach this problem we use Machine Learning and Neural Network algorithms to provide classification techniques. K-Nearest Neighbors classification technique is one of the supervised learning algorithms which has intense application in areas such as pattern recognition, intrusion

detection and data mining. On the other hand Multi Layer Perceptrons (MLPs) is comprised of an important class of feed-forward Artificial Neural Networks (ANNs), primarily aimed to replicate learning and generalisation abilities of a person with an attempt to model the functions of biological neural networks. In this paper our aim is to establish the usefulness of the MLP as a pattern classifier compared to the K-Nearest Neighbor (KNN) classifier used as a suboptimal traditional classifier.

II. LITERATURE REVIEW

Forest fires pose significant threats to ecosystems, societies, and economies worldwide. To minimize losses and reduce forest fires, modeling and predicting their occurrence can support fire prevention and management efforts. Recently, convolutional neural networks (cnns) have become state-of-the-art deep learning algorithms, and their implementation has enriched various fields. In this context, a spatial prediction model for forest fire susceptibility using a CNN was proposed. The study utilized past forest fire locations in Yunnan Province, China, from 2002 to 2010, and a set of 14 influencing factors for forest fires, which were mapped using geographic information systems. The researchers applied oversampling to eliminate class imbalance and proportional stratified sampling to construct the training/validation sample libraries. They designed a CNN architecture suitable for predicting forest fire susceptibility and optimized hyperparameters to improve prediction accuracy. Then, they fed the test dataset into the trained model to create the spatial prediction map of forest fire susceptibility in Yunnan Province. The performance of the proposed model was evaluated using several statistical measures, including the Wilcoxon signed-rank test, receiver operating characteristic curve, and area under the curve. Results confirmed that the CNN model had higher accuracy (AUC 0.86) than the benchmark classifiers, including random forests, support vector machine, multilayer perceptron neural network, and kernel logistic regression. The CNN has stronger fitting and classification abilities, making it a promising alternative for the spatial prediction of forest fire susceptibility. This research extends the application of CNN to predicting forest fire susceptibility and can support forest fire prevention and management efforts.

Another approach to forest fire detection involves a vision-based method for detecting fires from fixed surveillance smart cameras. This method integrates several techniques adapted to cope with the challenges related to the actual deployment of the vision system. Background subtraction is performed with a context-based learning mechanism to attain higher accuracy and robustness. The computational cost of a frequency analysis of potential fire regions is reduced by focusing its operation with an attentive mechanism. To discriminate quickly between fire regions and fire-colored moving objects, a new color-based model of fire's appearance and a new wavelet-based model of fire's frequency signature are proposed. To reduce the false alarm rate due to the presence of fire-colored moving objects, the category and behavior of each moving object are taken into account in decision-making. To estimate the expected object's size in the image plane and to generate geo-referenced alarms, the camera-world mapping is approximated with a GPS-based calibration process. Experimental results demonstrate the ability of the proposed method to detect fires with an average success rate of 93.1% at a processing rate of 10 Hz, which is sufficient for real-life applications. This method has potential in supporting forest fire management efforts.

In the context of emergency events involving fires, fast and precise decision-making is crucial. Crowdsourcing images and videos on crisis management systems can aid in these situations by providing more information than verbal/textual descriptions. To discard non-relevant content without losing relevant information, automatic solutions are needed because of the usual high volume of data. Several methods for fire detection on video using color-based models exist, but they are not adequate for still image processing and can suffer from high false-positive results. These methods also suffer from parameters with little physical meaning, making fine-tuning a difficult task. In this context, a novel fire detection method for still images that uses classification based on color features combined with texture classification on superpixel regions is proposed. This method uses a reduced number of parameters compared to previous works, easing the fine-tuning process. Results show the effectiveness of the method in reducing false-positives while maintaining precision compatible with the state-of-the-art methods.

Finally, in this paper, an application of artificial neural networks to the real-world problem of predicting forest fires is presented.

III. EXISTING SYSTEM

A wildfire, which is often known as a forest fire, brush fire, or bushfire, is an uncontrolled fire mainly occurring in wildland areas, which is also capable of consuming houses or agricultural lands. Analysing and Identifying the accurate patterns of the causes of these fires is a major problem as physical sensors and fire detectors get damaged in the fires and it is not feasible to place sensors in all the places. The system made use of naive bayes, Random Forest classifier in WEKA software for evaluation of the result.

IV. PROPOSED SYSTEM

To approach this problem we use Machine Learning and Neural Network algorithms to provide classification techniques. K-Nearest Neighbors classification technique is one of the supervised learning algorithms which has intense application in areas such as pattern recognition, intrusion detection and data mining. On the other hand Multi Layer Perceptrons (MLPs) is comprised of an important class of feed-forward Artificial Neural Networks (ANNs), primarily aimed to replicate learning and generalisation abilities of a person with an attempt to model the functions of biological neural networks.

V. IMPLEMENTATION

Implementation refers to the process of transforming a new or updated system design into an operational one. There are three types of implementation, which include replacing a manual system with a computer system, replacing an existing computer system with a new one, and modifying an existing application to replace it with a new one. In the Generic Tool project, implementation is carried out across all modules. The first module involves user identification to prevent illegal access, while the Table Creation module allows users to create tables with specific conditions and constraints. The Updating module enables users to update or delete records, while the Reporting module generates reports in either 2D or 3D views based on

selected tables and specified conditions. The Generic tool maintains user requirements throughout the project

This code is straightforward. First, it prints a “Content-Type” line, followed by a blank line, as required by CGI. It prints some introductory HTML, connects to a database and executes a query that retrieves the latest ten books. Looping over those books, it generates an HTML unordered list. Finally, it prints the closing HTML and closes the database connection.

With a one-off dynamic page such as this one, the write-it-from-scratch approach isn’t necessarily bad. For one thing, this code is simple to comprehend — even a novice developer can read these 16 lines of Python and understand all it does, from start to finish. There’s nothing else to learn; no other code to read. It’s also simple to deploy: just save this code in a file called latestbooks.cgi, upload that file to a Web server, and visit that page with a browser. But as a Web application grows beyond the trivial, this approach breaks down, and you face a number of problems:

Should a developer really have to worry about printing the “Content-Type” line and remembering to close the database connection? This sort of boilerplate reduces programmer productivity and introduces opportunities for mistakes. These setup- and teardown-related tasks would best be handled by some common infrastructure.

What happens when this code is reused in multiple environments, each with a separate database and password? At this point, some environment-specific configuration becomes essential.

What happens when a Web designer who has no experience coding Python wishes to redesign the page? Ideally, the logic of the page — the retrieval of books from the database — would be separate from the HTML display of the page, so that a designer could edit the latter without affecting the former.

These problems are precisely what a Web framework intends to solve. A Web framework provides a programming infrastructure for your applications, so that you can focus on writing clean, maintainable code without having to reinvent the wheel. In a nutshell, that’s what Django does.

VI. CONCLUSION & FUTURE ENHANCEMENTS

By our model, we tired to get insights into the data that will be helpful in making effective decisions for the detection of wildfire. In this paper, we have generated fire detection and classification models using multilayer perceptron algorithm and K-Nearest Neighbor algorithm and compared them with each other. The Multilayer perceptron algorithm has the highest accuracy with 99.96%. The accuracy of this algorithm is higher than the accuracy of K-Nearest Neighbor algorithm . Future work can include a comparison of the other more up-to-date algorithms obtaining high accuracy as well as less complexity.

Whenever you hear someone bemoaning AI and machine learning as the end of civilisation, remind them of Data61, the CSIRO’s robotics and AI division. Data61 is home to the Evacuation Modelling Team, who use algorithms and neural networks to improve bushfire

planning and emergency response. The technology is pretty interesting. The AI-driven Decision Support System can analyse the predicted impact of a bushfire on road networks, run evacuation simulations, and even feed emergency services accurate data about the "[Our team] showed the computer a scenario based on Australia's climate between 2001 and 2010," the CSIRO says. "The AI was able to replicate the real world occurrence of fire hotspots with 90 per cent accuracy at the 5 x 5 kilometre scale." .

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