1. Introduction

Forest and land fires has been one of the problematics in Indonesia, particularly in Borneo. Indonesia contributes for a considerable proportion of Southeast Asia's forest area and currently occurring one of the world's highest deforestation rates, second to Brazil [1]. Forest fire is a part of nature caused by natural (lightning) or unnatural (human error) causes. It occurs periodically during the dry season where the lands are covered by peat land. It means that the land covered may determine the level of fire event. The vegetation type and soil characteristics also contribute to the development of fire occurred in forest fire. Along with climate change, regions that have a great fuel consumption are becoming suspectible to the intensity of forest fire. Forest fire produces an abundant amount of greenhouse gases to the atmosphere and becomes one of the causes of the interannual variability in the growth rates of several trace gases. This may cause public health problems since pollutant emissions from large-scale forest fire include carbon monoxide (CO). According to the data from Ministry of Environment and Forestry, in 2019 fire burnt approximately 1.6 million ha of forest and land in Indonesia where the most affected regions were Central, West and South Borneo.

Background

Forest fire prediction has become important to prevent forest fire from occurring and to make first response when the fire occurs [2]. If fires are not detected early, they may become out of control and the consequences are often disastrous. The model for forest fire prediction represents an essential tool to predict forest fire risk, damage, forest fire monitoring and extinction phase, and to assist in the fire control planning and protecting both human life and property. Today many fire risk models make use of forest fire databases to construct and assess probabilistic models.

Many recognition-based problems commonly can be solved with classical algorithms such as decision tree (DT) and random forest (RF). However, these classical algorithms all require complex and time-consuming feature engineering, which requires not only designing of extracted features manually, but also features selection or dimensionality reduction to screen out the best representative features [3]. The advancements in Machine Learning, called Deep Learning emerged as machine learning algorithms. Amongst contemporary approaches, Deep Learning.

(DS) has risen into an attractive approach in this topic. Deep Neural Networks provide a potent mechanism that allows for learning complex mappings from raw data automatically, avoiding the need for developing hand-crafted features [4]. This algorithm shows an exceptional performance for computer vision application, including object detection and image classification. These advancements inspired the framework to encode time series data as distinct types of images, namely Grammian Angular Field (GAF). This enables the use of computer vision for classification. Using coordinate system, GAF images are represented as matrix where each element is trigonometric sum between different time intervals. Another method we are using is called Convolutional Neural Networks (CNN). CNN converts transitional invariance within structures by extracting features from image input. The features are then inserted into the Long Short-term Memory (LSTM) to classify weight, posture and then updated through repeated training process until generates the best performance. Compared to the classical algorithms, CNN got better recognition performance and training time.

Topic and Limitations

This study is limited to only using multivariate timeseries data as the input data and only researches the forest fire in Borneo. Based on the previous research, the forest fire hotspot prediction model will be implemented using GAF CNN-LSTM by processing time-series data. The datasets used in this study will be taken from public sources which are daily data from 1998 to 2022. The data obtained will be converted to an image using GAF method and CNN method will be implemented to classify multivariate datasets while the LSTM will be implemented to predict the hotspot of the forest fire by considering the given variables.

Goals

This study aims to find a model that can predict forest fire, find the related variables that supports the occurrence of forest fire and implement the suitable model for the given problems and evaluate the result to compare.

Writing Organization

Literature review is explained later in the second section, which contains theory, definition, and related study that supports this research. The third section contains the system design of the model to be made. Fourth section contains the systematics of the data treatments. Fifth section contains the result and evaluation of the model as well as the conclusion and further research suggestions.