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Abstract

This paper presents a novel Multi-DL Fuzzy Approach aimed at performing image recognition in the development of a real-time traffic alert system, addressing the problem of traffic congestion and related incidents. Traditional monitoring by road operators predominantly relies on fixed location cameras, yielding limited and sometimes ambiguous information. This study proposes leveraging Twitter (now known as 'X') as a more comprehensive data source alongside employing fuzzy techniques with Deep Learning (DL) neural networks such as CNN, VGG16, and Xception to analyze and classify traffic images. The innovative integration of these technologies augments the precision in categorizing varying traffic conditions, namely fluid and dense traffic, accidents and fires. Thus, this proposal mitigates the ambiguities prevalent in traffic image interpretation, and reduces the dependency on static data sources. The proposed models showed improved results by combining information from the DL models, elevating accuracy from 84% in crisp classification to 90% utilizing fuzzy information.

Keywords

traffic monitoring, deep learning, fuzzy classification, alert system, image recognition, real-time system

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1 Introduction

Traffic congestion is an important problem in our modern society, affecting millions of citizens worldwide [4]. It not only affects urban areas in large cities, but also occurs frequently on most roads that provide access to those cities or that circumnavigate them. While applications like Google Maps or Waze offer real-time traffic congestion alerts to drivers, there is also a need for road operators (public entities or private companies) to monitor this problem using their own data sources and other available open data, without depending on third-party services [1]. In this manner, these road operators will be able to act more appropriately in the different situations that lead to traffic congestion (accidents, massive arrival of vehicles, or unplanned lane blockage).

Typical data sources owned by road operators to monitor traffic are in the form of sensors such as inductive loop detectors [25], microwave radar detectors, and video cameras. While the two first elements may be effective for tracking the passage of vehicles and measuring speed, video cameras offer a more compelling alternative to obtain a better view of the current traffic situation at a specific point on a road. However, a road operator may manage hundreds or even thousands of cameras to oversee the entire road network, with data updating at intervals of just a few minutes. This volume of data can make it challenging for a human operator to detect all potential traffic problems in real-time.

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