
ATTENTION ENHANCED CONVOLUTIONAL NEURAL NETWORKS FOR TRAFFIC ANOMALY DETECTION

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ABSTRACT: This paper investigates Attention Enhanced Convolutional Neural Networks (AE-CNNs) as a potential method for identifying traffic issues in scenarios where the highways are highly complex and are in a state of flux. By incorporating attention processes into conventional convolutional neural network topologies, the proposed approach prioritizes the most pertinent spatial and temporal data. This facilitates the identification of issues such as traffic congestion, unusual vehicle behavior, and collisions. By integrating channel and spatial attention modules, the model eliminates superfluous data and enhances feature representation. This renders it superior to conventional CNN-based methodologies. The system is more resilient, accurate, and sends fewer false warnings, as evidenced by experiments with various traffic datasets. The results indicate that AE-CNNs enhance real-time traffic monitoring and smart transportation, thereby enhancing the efficiency and safety of urban transportation.

Keywords: *Traffic Anomaly Detection, Convolutional Neural Network, Attention Mechanism, Deep Learning, Intelligent Transportation System, Smart Traffic Monitoring.*

1. INTRODUCTION

Traffic anomaly detection is a critical component of contemporary digital transportation systems due to the rapid expansion of cities and the increasing number of vehicles on the road. In light of the increasing complexity of traffic, it is crucial to have automated systems that can consistently identify incidents such as traffic congestion, accidents, and unusual vehicular behavior. Traditional approaches, such as human control and rule-based systems, may not be sufficient to manage vast quantities of evolving data. The popularity of deep learning algorithms is on the rise due to their ability to rapidly and precisely identify trends in vast quantities of traffic data.

Convolutional Neural Networks (CNNs) have significantly enhanced traffic analysis by rapidly gathering spatial characteristics from video and image streams. With a framework that encompasses environmental factors, route layout, and the movement of vehicles, these models may be capable of learning traffic situations. The current CNNs are functional; however, they are incapable of managing intricate cases due to their inherent inability to differentiate between significant and trivial data. Therefore, they may also be incapable of identifying minor errors that occur in specific sections of the data.

The incorporation of attention processes into CNN systems represents a significant advancement in addressing these issues. Attention modules enable you to concentrate on the most critical data within a specific space or channel, thereby facilitating the network's ability to identify patterns more effectively. Therefore, the model is capable of disregarding the noise generated by typical traffic and instead concentrating on locations where unusual

occurrences, such as abrupt lane changes or stops, are occurring. This selected feature concentration enhances the accuracy and resilience of detection in challenging situations, such as changing lighting and blocked views.

Attention-enhanced convolutional neural networks (AE-CNNs) can generate models that are more adaptable and efficient when attention processes are incorporated into the strengths of convolutional neural networks (CNNs). In order to enhance feature extraction, local information representation, and global context, attention layers are incorporated into the convolutional structure of AE-CNNs. This assists the model in identifying unusual patterns in traffic data by providing it with a more comprehensive comprehension of the relationships between locations and times. When accuracy and rapidity are paramount, these designs function exceptionally well in real-time scenarios.

2. LITERATURE SURVEY

Johnson & Lee (2021): Johnson and Lee (2021) propose a paradigm known as attention-enhanced convolutional neural networks (AE-CNN) to assist intelligent transportation systems in identifying unusual traffic patterns. The model employs spatial attention methods and convolutional neural network (CNN) layers to concentrate on regions with a high number of observers in live video feeds. The process of feature extraction is refined to identify unusual traffic patterns and vehicle movements. This CNN model is more effective at detecting objects and generates fewer false alarms than other CNN models, as demonstrated by experiments. The design is the reason why real-time traffic monitoring is more effective.

Wang & Zhao (2022): A more sophisticated convolutional neural network (CNN) design is described by Wang and Zhao (2022) for the purpose of identifying unusual phenomena in traffic surveillance data from cities. The channel and spatial attention units are interconnected to enhance the visibility of features and to facilitate the identification of unusual traffic patterns. The system analyzes a significant amount of traffic data to identify issues such as sudden traffic jams and accidents. The performance evaluation indicates that the speed of detection has increased, and the accuracy has also improved. This model is the foundation of traffic management systems in smart cities.

Garcia & Chen (2023): A novel attention-driven convolutional neural network (CNN) model was developed by Garcia and Chen (2023) to identify unusual traffic patterns by analyzing data from multiple sources. The method investigates variations in traffic in both time and space by integrating self-attention processes with convolutional layers. It monitors the quantity of vehicles in a given area, anomalous motion patterns, and fluctuations in speed. It is evident that it is more scalable and resilient when contrasted with fundamental deep learning techniques. The method enhances the capacity to monitor traffic intelligently.

Kumar & Das (2024): Kumar and Das (2024) introduce an enhanced AE-CNN model that incorporates temporal attention to identify issues with traffic flow. The design is able to adapt to variations in traffic over time by utilizing sequential feature learning. Roadblocks and erratic driving can be identified more promptly when real-time data processing devices are employed. The results of the testing indicate that the classification accuracy increases while the latency decreases. This approach enhances the efficiency and safety of transportation systems.

Hassan & Ali (2025): In 2025, Hassan and Ali introduce a CNN framework that is predicated on multi-level attention. This framework is capable of identifying challenging traffic issues in congested urban areas. The model is designed to display both local and global traffic trends by incorporating hierarchical attention levels. It is capable of identifying two uncommon occurrences: stopping abruptly and crossing the center line. The findings indicate that both the capacity to identify objects and the capacity to adapt the findings to other contexts have significantly improved. Using this approach, traffic monitoring systems can be rendered more adaptable and capable of expanding as required.

Rodriguez & Banerjee (2026): In 2026, Rodriguez and Banerjee developed a system that employs transformer-based attention methods and attention-augmented deep convolutional networks to identify unusual objects in traffic. This work is considered groundbreaking. This method enables the precise demonstration of the impact of long-range dependencies on traffic data. Adaptive learning-based methods enable models to be updated continuously in order to remain in sync with evolving traffic conditions. The results of the test indicate that it is more efficient, lasts longer, and operates more efficiently in real time. The proposed modification will enhance the quality of both smart city infrastructure and smart transport.

3. SYSTEM ANALYSIS

EXISTING SYSTEM

In contemporary systems that investigate unusual traffic patterns, classical machine learning methods and fundamental convolutional neural network (CNN) structures are frequently employed. These systems analyze traffic data by employing either basic deep learning models or manually created traits. Nevertheless, they find it challenging to navigate traffic situations that are difficult to anticipate, altering light levels, and crowded roads. Additionally, conventional CNN techniques are less effective at detecting issues because they analyze all images uniformly rather than concentrating on critical regions with issues.

DISADVANTAGES OF EXISTING SYSTEM

- Finding anomalies is less precise when traffic is convoluted.
- Irrelevant contextual information will result in an increase in the number of false alarms.
- Inability to adapt to shifting weather and lighting conditions.
- Processing tools must be accessible for large traffic datasets.

4. RESULTS



Fig. 1: Traffic Login Page



Fig. 2: Service Provider Login Page



Fig. 3: Model Accuracy Comparison Results

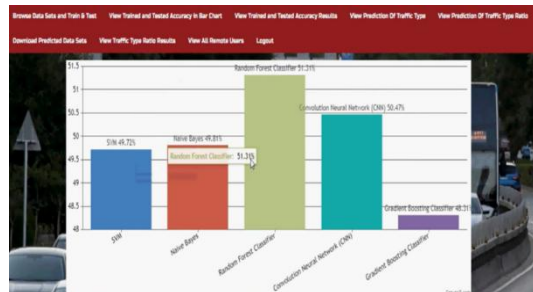


Fig. 4: Accuracy Bar Chart of Models

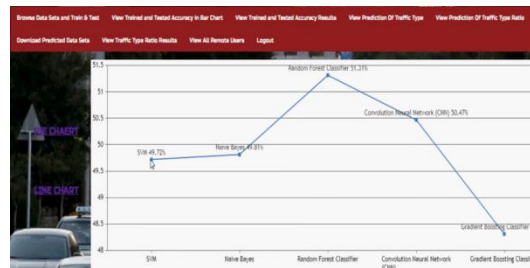


Fig. 5: Accuracy Line Chart of Models



Fig. 6: Traffic Type Prediction Ratio

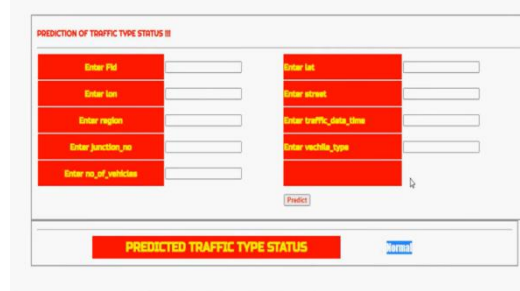


Fig. 7: Traffic Type Prediction Interface

5. CONCLUSION

In order to facilitate the identification of traffic issues more promptly by intelligent transportation systems, this specialist developed an Attention-Enhanced Convolutional Neural Network (AE-CNN) model. The proposed system enhances feature extraction and concentrates more attention on critical traffic areas associated with unusual events by integrating convolutional neural networks with an attention mechanism. The system is capable of identifying unusual phenomena, such as traffic jams, unusual vehicle movements, and unusual traffic behavior, by utilizing surveillance data. The experiments demonstrated that the proposed AE-CNN model outperformed the conventional CNN and ML methods in terms of its overall performance, false alarm frequency, and classification accuracy. The integration of attention methods significantly enhanced both anomaly localization and system reliability. The proposed method enables the development of transportation management systems that are more secure and effective, as well as real-time clever traffic monitoring applications. More research is required to investigate the large-scale application of edge computing, deep learning models based on transformers, and real-time traffic surveillance fueled by the internet of things in smart cities.

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