Chapter 5
Road Space Rationing Using Vehicle's Automated License Plate Recognition: A Comprehensive Survey of Methods

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ABSTRACT

The exponential rise in volumes of motor vehicles all over the world has led to increased pollution and negative impact on climate. Therefore, road space rationing

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is one strategy to control traffic volume which allows even/odd number plates on alternate days. However, it requires Automated License Plate Recognition (ALPR) systems for real time monitoring. Machine intelligence based ALPR uses multiple technologies to offer robust performance under varying imaging conditions, such as high velocities, low light, harsh weather, camera vibration, and partially obscured images. Furthermore, the radical shift from conventional to deep learning (DL) methods also requires developing tools and data-sets which are capable of handling diverse character sets in multiple languages. This scoping review offers a comparative analysis of various approaches in ALPR systems where AI and deep learning algorithms are found to offer superb performance and high recognition rates of greater than 90% after compiling the contents of around 100 published articles during 1997-2023.

1 INTRODUCTION

The continued increase in world population has led to a significant rise in the number of vehicles on the road, which has necessitated the implementation of various automatic surveillance and detection systems. Historically, New York receives credit for being the first city to adopt a unique license plate number for each vehicle in 1901, as a means of vehicle tracking, and has since become a widespread practice. However, it wasn't until 1976 that the Police Scientific Development Branch developed the ALPR technology, as documented by (Singh, 2016). Analyzing the development and application of ALPR systems throughout history as it shown in Figure 1, reveals a gradual progression of technological advancements. In the 1970s, ALPR systems relied on basic image processing as the primary technology, finding initial use in experimental law enforcement applications. Notably, the Police Scientific Development Branch in the UK pioneered an ALPR system using rudimentary image processing techniques. In the 1980s, advancements in image processing and data storage facilitated ALPR evolution. The U.S. Customs Service deployed these system at the US-Canada border for monitoring vehicle movements linked to smuggling and criminal activities. This marked the inception of modern ALPR systems in law enforcement and vehicle identification (Jia, 2007). The history of ALPR can be seen in Figure 1 which shows a sharp development during 90s, when enhanced cameras and improved image processing algorithms enabled ALPR systems to read license plates from various angles and lighting conditions. Integration with databases further amplified ALPR adoption in law enforcement globally, enabling automated scanning and database comparisons for stolen vehicles and suspects. The 2000s witnessed integration with digital systems and enhanced image recognition (Rahman, 2021). ALPR expanded its reach to include toll collection and traffic management,