Chapter 3
Incorporation of Fuzzy Logic and Pattern Recognition in Transportation Engineering

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ABSTRACT

In recent decades, there has been a fast rate of development in many countries and urbanization has also risen noticeably over time. Moreover, the desires and budget of middle-class people to afford their personal vehicles have become a reality in a number of countries in the world over the decades. However, even though this sounds nice, the limited land area and resources led to high traffic congestion apart from the considerable number of annual traffic accidents in many countries across the world. This chapter will focus on Fuzzy Logic as well as Pattern Recognition methods and tools implementation in the field of Transportation Engineering. The book chapter will explore the need and utility of these two tools and methods in the Transport Sector. Then, some case studies across the globe will be covered, apart from the current gaps in existing literature, in addition to benefits as well as problems associated with the implementation of both of these methods and tools. Then, some graphical analysis will be performed to understand the future of Pattern Recognition as well as Fuzzy Logic in the transport field.

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INTRODUCTION

Singh (2022) explained about Fuzzy Logic (FL) in his study, where he mentioned that on the occurrence of things being vague or uncertain, the word fuzzy enters the picture. He talked about that significant flexibility comes with the type of logic which is multi-values called Fuzzy Logic in the case of partial false as well as partial false, when nothing is absolute true or absolute false. This is represented by real numbers which are present between the numbers 0 and 1. In his study, he particularly focused on the usefulness of Fuzzy Logic in the area of Traffic as well as Transportation Engineering, but to proceed forward with this chapter, it is important to have a quick glance on Fuzzy Logic first. In his study, he explained about the architecture of Fuzzy Logic, which consists of Inference Engine, Rule Base, Defuzzification, in addition to Fuzzification. Apart from that, he talked about Fuzzy Logic's Membership Functions as well as Fuzzy Control in brief, as well as how it could be implemented in road traffic to improve the traffic situation along with the reduction of considerable number of road accidents possible in the Indian state Goa. This is because of the ability of Fuzzy Logic, able to impersonate the way decisions are made by people on the basis of indefinite information as well as rules, while handling the uncertain situations properly where input data is generally vague, and flexibility in permitting a variety of inputs as well as outputs, which makes it suitable for several situations and areas. This is why Fuzzy Logic is a precious tool in Transportation Engineering, in the case of not only managing but also modeling complicated indefinite situations, when definite rules or data are hard to describe. So, controlling vehicles as well as traffic, and transportation planning could be benefited from Fuzzy Logic, while giving efficient as well as adaptable solutions on the basis of imprecise input data. Therefore, traffic flow modeling, route planning, optimization of traffic signal, planning of public transport, modeling of route choice, up to certain extent in developing transport infrastructure, control of automated vehicles, assisting in intelligent parking systems, control of adaptive cruise, development of decision support systems in the case of transport planning, and optimize operations in the case of freight transport as well as logistics, could be done with the implementation of Fuzzy Logic.

Now, it is time to understand Pattern Recognition (PR), which is an area, where not only understanding but also detecting recurring structures or sequences within information or data is performed. In other words, Pattern Recognition is about classifying as well as identifying patterns, including identifying handwriting, distinguishing speech, in addition to detecting shapes in a given image. So, it can be said that it is a cognitive process, as matching novel info with the already stored memory or knowledge is done. It is used in a number of fields such as computer vision, medical diagnosis, image processing, biometric authentication, and speech