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PASSAGE THROUGH INDIA

A new customized automatic vehicle classification system that relies on double-wheel detection and 3D profiling is able to cope with the wide variety of vehicles within India's domestic fleet, meaning that tolls are accurately charged

In an effort to modernize and homogenize the operation of highway concessions, the Indian administration has defined a set of common specifications that establishes the way tolls are collected. Automatic vehicle classification (AVC) is a particularly hot topic in this sector. AVC is used in manual tolling for back-office verification of the class declared by the toll attendant. It's also used in electronic tolling for calculating transaction fees. In both scenarios, high reliability is required – neither an audit system nor a revenue-collection system can rely on uncertain data.

The main challenge of implementing AVC systems in India is the wide variety of vehicles in the fleet. An added difficulty is the environmental conditions, with any device needing to be resistant to extreme heat and humidity. By using suitable sensors and smart classification software, accurate AVC can be implemented, which is capable of recognizing most vehicle types within the fleet. Such a system has been delivered by Spanish firm Tecsidel in integration with software development company Ashoka Technologies, and is already deployed on an Indian toll road project operated by Ashoka Buildcon.

DEFINITION OF VEHICLE CLASSES

As defined by the National Highways Authority of India (NHAI), vehicles are divided into four classes for the purpose of tolling: light motor vehicles or LMVs and three-wheelers (Class 1); light commercial vehicles or LCVs (Class 2); heavy vehicles and buses (Class 3); and multi-axle vehicles (Class 4). Other types of vehicles, mainly two wheelers, are not chargeable.

In an attempt to standardize these classes and make them recognizable automatically, specific rules have been established based on the total number of axles of the vehicle and the height above the first axle. Vehicles in the first three classes all have two axles, whereas vehicles in the fourth class have more than two. In order to distinguish the first three types of vehicle, the height above the first axle is used. For Class 1 it is lower than 1.97m, for Class 2 it's between 1.97-2.4m, and for Class 3 it is higher than 2.4m.

Example of LCV with decorations on the roof

Light commercial vehicle with a low front part

The task of measuring characteristics is difficult not only as a result of the heterogeneity of the fleet but also due to other common scenarios, such as vehicles loaded beyond their limits or decorated with objects that mislead the automatic recognition of the class parameters. Such exceptions are so frequent that a basic AVC system cannot provide reliable results.

The main confusion exists between Classes 1, 2 and 3 as they are based on the same number of axles (two). Multi-axle vehicles can easily be distinguished from other classes by using axle-counting sensors. The most usual misleading cases include LCVs with a low front part, LCVs with decorations on the roof, and heavy vehicles with a low front part. An AVC system based solely on axle counting and height above first axle would wrongly classify them as LMVs, heavy vehicles and LCVs, respectively. Other types are also hard to classify, such as mini vans, which are often too high to be considered as LMVs, or vehicles with trailers, especially if loaded with packages.

To overcome these problems, Tecsidel has developed an enhanced AVC system that includes new features such as double-wheel detection and vehicle profiling. Double wheels are detected by means of oblique treadles, while vehicle profiling is performed with an overhead laser scanner and smart shape-recognition software.

A first rule is applied based on the fact that trucks of Class 3 or 4 always have double wheels, whereas Class 2 LCVs may or may not. It is thus possible to ascertain that a vehicle without double wheels is not a heavy vehicle, which enables a high percentage of potentially confusing cases to be discarded.

Profiling techniques are mainly used to accurately classify two-axle vehicles. Instead of only measuring the height above the first axle, the profiler also provides 3D information. Furthermore, a shape analysis of the front of the vehicle is conducted, which recognizes 'flat', 'steep' and 'vertical' fronts, so it's possible to classify LCVs or heavy vehicles with low front parts properly by taking into account profile measurements, rather than just the height above first axle. And width measurement allows motorcycles and three-wheelers to be distinguished also.

Such enhancements enabled the number of errors to be reduced by 80% (i.e. out of five errors, four were corrected), up to levels that were acceptable for the toll operator.

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