

## Chapter 59

# Intelligent Control of Vehicles' Number Plates on Toll Gates in Developing Nations

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### ABSTRACT

*Developing nations have implemented toll gates in their countries major trunk highways as a move towards the improvement in fiscal levels. However, several problems have arisen in the toll collection system that has been implemented. The system exists as an incomplete system in comparison to internationally acclaimed systems and methods. This chapter therefore seeks to introduce an automated toll collection system which has enhanced security features and intelligent vehicle classification methods. Utilising machine intelligence and computer vision methods in the system, the researchers intend to develop the automated and intelligent toll collection system for developing nation's toll gates. The mechatronic system will combat security loopholes and enhance the efficiency of the toll collection process.*

### 1. INTRODUCTION

Tolling as a method of financing the transportation system is becoming more common in the United States. Neither the traveling public nor State Departments of Transportation want vehicles to stop or slow down to pay to use a toll facility. To this end, several technologies, collectively called Electronic Toll Collection (ETC), have been developed in the last 15 years, allowing drivers to move in and out of toll systems without delay. Open Road Tolling (ORT), with all-electronic toll collection, is now the preferred practice, being more efficient, environmentally friendly, and safer than manual toll collection.

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Whilst technological advances have been realised in various areas of the Zimbabwean society, some areas are still lagging and these urgently require attention. Of note is the development of toll gates which were introduced in Zimbabwe in order to aid in maintaining road maintenance and fiscal levels. To date over 57 million dollars has been collected through the nation's toll collection system. However, several inconsistencies and issues have surrounded the implementation of the toll collection system. There are three main reasons why tolling, or road pricing, is implemented (Wikipedia: Road Pricing, 2006):

- **Finance/Revenue Generation:** To recoup the costs of building, operating and maintaining the facility. Road pricing is becoming a more appealing means of funding transportation, since revenues from federal and state gas taxes have not kept up with growth in demand for infrastructure. Moreover, toll financing allows projects to be built sooner instead of waiting for tax revenues to accumulate.
- **Demand Management:** To moderate the growth in demand on the transportation system, and to encourage more use of public transportation and carpooling. For example, vehicles are charged to enter inner London, England, as a way of regulating the demand in the region.
- **Congestion Management:** To place a price on limited roadway space in proportion to demand. In this application, the toll increases with the level of congestion. In the absence of such pricing, drivers do not appreciate the costs they impose on others as a result of the congestion they cause.

### **1.1. Background of the Problem**

The method of collection is still manual for the various classes of the vehicles which pass through a toll collection point. Historically, toll counters have been installed in various highways within Zimbabwe's road networks. Such have allowed for the demographic modelling of traffic density on the networks. These toll data loggers have aided in determining the possible lifespan of a highway given the traffic density recorded for the system. The collection of toll fees is dependent upon the operator's presence at the toll collection site. In instances when harsh weather conditions arise, the toll collection officers tend to leave some sites unattended and this results in a loss of revenue which is significant on a national level when analysed cumulatively. Within the area of coverage, the patrol vehicle is used and the patrol officer will perform spot audits and inspections of the activities on the toll site. It has however occurred that the present system has safety loopholes for the toll operators and this arises from the ergonomics of the present system. Auditing of the toll collection system is usually a tedious process for the auditors in revenue collection. Fraudulent behaviour has gone unnoticed and this has occurred in instances which the local press could substantiate on. High volumes of traffic stimulate a congested environment on toll gate sites as the human operator's responsiveness is based on mental alertness and agility as well as fatigue levels (This is mainly evident during public holidays).

Zimbabwe is yet to develop and automate a toll collection system which caters for various challenges that the manual system presently faces as cited above. The inefficiency of the previous system will require to be addressed through such a system. At present investment is being made towards the enhancement of service on the toll gates and the whole infrastructure.

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