# A Cloud-Based Intelligent Toll Collection System for Smart Cities

Segun I. Popoola[1(✉)], Oluwafunso A. Popoola[1,2], Adeniran I. Oluwaranti[2], Aderemi A. Atayero[1], Joke A. Badejo[1], and Sanjay Misra[1]

[1] Department of Electrical and Information Engineering, Covenant University, Ota, Nigeria
segun.popoola@covenantuniversity.edu.ng
[2] Department of Computer Science and Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria

**Abstract.** Electronic Toll Collection (ETC) systems may be adopted by city managers to combat the problems of long vehicular queues, fuel wastage, high accident risks, and environmental pollution that come with the use of traditional or manual toll collection systems. In this paper, an intelligent system is developed to eliminate long vehicular queues, fuel wastage, high accident risks, and environmental pollution in a smart city based on seamless interconnections of Wireless Sensor Networks (WSNs), and web and mobile applications that run on an Internet of Things (IoT)-Enabled cloud platform. A ZigBee WSN is designed and implemented using an Arduino UNO, XBee S2 radios, an XBee Shield, and a Seeduino GPRS Shield. For vehicle owners to make toll payments, view toll historical data, and get toll news feeds, a web application and a mobile application are designed and implemented based on Hyper Text Mark-up Language (HTML), Cascading Style Sheets (CSS), Javascript and Hyper Text Pre-processor (PHP). The mobile application is deployed using an Android platform. A cloud platform was also developed to provide business logic functionalities by using PHP as a scripting language, and MySQL as the database engine driver. Deployment of the developed ETC system in smart and connected communities will drastically minimize the challenges of long vehicular queues, fuel wastage, high accident risks, and environmental pollution in urban centers.

**Keywords:** Smart city · Electronic Toll Collection · Internet of Things
Mobile application · Cloud computing

## 1 Introduction

Applications of Intelligent Transportation System (ITS) technologies is highly encouraged in emerging smart cities to handle the current challenges of the continuous growth in the number of vehicles that ply the highways in urban centers [1]. Electronic Toll Collection (ETC) systems may be adopted by city managers to combat the problems of long vehicular queues, fuel wastage, high accident risks, and environmental pollution that come with the use of traditional/manual toll collection systems [2].


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