BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

PROJECT REPORT

AUTOMATIC VEHICLE TOLLING SYSTEM

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DECLARATION

I, **SSEBABI MARTIN**, Registration Number; **BU/UG/2012/94**, declare that the work in this report is original except where indicated by explicit citation in the text and no part of this report has been submitted to any other Institution of higher learning for any academic award.

Signature……. Date……

APPROVAL

This is to certify that the project report under the title ”*Automatic Vehicle Tolling System*” has been done under my supervision and is now ready for examination.

Mr. Bwire Felix

Department of Computer Engineering

Signature: …… Date: ……

LIST OF ACRONYMNS

DSRC	Dedicated Short Range Communications
ANPR	Automatic Number Plate Recognition
AVI	Automated vehicle identification
RFID	Radio-frequency identification
APMs	Automatic Payment Machines

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ABSTRACT

Radio frequency Identification (RFID) consists of the tags which can be either active or passive tag. Passive tag, which I employed, do not have own power supply, much cheaper to manufacture and small coil antenna is used. Basically, an RFID system consists of an antenna or coil, a transceiver (with decoder) and a transponder (RF tag) electronically programmed with unique information. RFID reader is an interrogator. It is placed at the toll gate on every single row where vehicles are passed. The reader contains an RF module, which acts as both transmitter and receiver of radio frequency signals. The reader generates the signal to receive the data from tag.

The received signals are sent to the computer system which contains Graphical User Interface (GUI) and the database of all users. The ID number from the tag checks with the recorded database and deduces the toll balance. The computer and microcontroller are connected with USB cable. So, the PIC microcontroller is very compatible for system. The microcontroller displays the amount of deposits on LCD and the gate opens. The IR sensors sense the vehicle presence for closing gate automatically.

User registration is achieved through the software part of this project. This has a database for storing user information and for handling the various transactions. An administrator is responsible for user registration and assigning RFID tag numbers to the user he registers. Once registered, this information can only be tampered while updating balance otherwise; the privileges are left entirely to the system owner.

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CHAPTER ONE

1.1 Background

Road transport in Uganda is the basic means of transport and this entails the use of public means as well as private means. The travellers use various modes of transportation including both cyclists and motorists [1]. The increased volume of taxis and buses has made the traffic condition and tax management in Kampala city very unfavorable. Kampala currently has over 12,000 taxis operating within the Central Business district and on major highways in and out of the city [2]. These numbers alone are tremendous however there also exists hundreds of privately owned means and also thousands of cyclists. Such huge numbers call for proper management and maintenance of certain infrastructure needed to handle them. First, there is need for proper parking places to effect city organization. For taxis, the taxi-park is the right option while private vehicles have to seek out private parking lots. All the mentioned places require for some form of maintenance and they levy some funds from the vehicle operators to do just this [3].

Much of Uganda's road network and the entire related infrastructure currently require substantial improvement or development to meet the current and forecast traffic demands, and to promote equal distribution of, and access to the economic and social development across the country. A lack of adequate and safe highway capacity has a disproportionate impact on the poor, who greatly rely on the road infrastructure to access labor markets and key services and are more likely to use less roadworthy vehicles [4].

Looking at the various taxi parks around Kampala, the dues imposed upon taxi operators are administered with the help of simple paper receipts. In most taxi-parks, such a receipt earns the taxi-driver passage out of the taxi-park after loading the passengers [5]. Taxi drivers however have learnt to dodge these payments with the help of fake receipts which are design in an exact replica of the actual receipts. The money collected is used to run the activities for maintaining the taxi park in proper order as well as paying those in charge of this place. For the parks in Kampala, authority of management is with the central body (KCCA), however each Taxi park has a body known as The Taxi Park Executive Committee. This is also under instructions of the KCCA and it is tasked with collecting all the park revenue and park maintenance [6].

Around Kampala, wherever such kind of revenue needs to be collected say along streets and on wide roads(parking fee), in taxi-parks and also privately owned parking spaces, different means ranging from the traditional paper receipts issued by the road side parking managers to the automatic payment machines that are self-managed, are employed to achieve effective revenue collection [4]. These means used currently are diverse however they all have their flaws which raise the need for a more efficient system with lesser human involvement to levy the aforementioned dues automatically from all the parties involved.

1.2 Problem statement

Vehicles, especially the commercial vehicles, working around various cities are subject to some form of operational payments. These payments are normally administered with the help of paper receipts and, to a lesser extent, raw money collections. On addition to being time consuming, these mechanisms are highly inefficient because the payments are always evaded and if not, the little revenue collected is always embezzled. This presents the need to design a system that can handle such kind of revenue collection in a more efficient and time saving manner with no human intervention hence the report for developing the automatic vehicle tolling system.

1.3 Objectives

1.3.1 Main objective

To design and implement a system that can automatically charge vehicles when they cross particular tolling points.

1.3.2 Specific objectives

i) To identify the requirements necessary for designing the stated tolling system.

ii) To design and implement a user interface module and its intended database.

iii) To design and implement the model of the gate control system for enforcement.

iv) To integrate the two modules so as to achieve the desired functionality

v) To test and validate the tolling system as proposed.

1.4 Justification

Tax evasion is prevalent in Uganda and considered one of the major sources of losses in the revenue collection sector. Looking at the taxi-parks around Kampala and also on numerous roads linking to highways, payments are effected with the help of receipts issued by the road and park authority. However, fake receipts also exist and embezzlement is also present hence the revenue collected was cut to the least. On addition, this whole process can be disturbing especially due to the time wasted therein. The evasion hinders the developments of which the collections are usually intended although it usually goes unnoticed.

1.5 Scope

The project accounts for the operations among various taxi parks within the country and also accounts for the policies used to charge the taxi-operators.

The project focuses on money collection and violation enforcement on the registered parties whenever necessary according to the policies set in the place of deployment.

Place of deployment must be enclosed having only the exit/entry gates as the only ways out.

CHAPTER TWO

LITERATURE REVIEW

This section includes related literature, review of the existing and related vehicle revenue collection systems, describing how they work and challenges related to using them.

2.1 Electronic toll collection

Electronic toll collection (ETC) is a technology enabling the electronic collection of toll payments. It has been studied by researchers and applied in various highways, bridges, and tunnels requiring such a process. This system is capable of determining if the car is registered or not, and then informing the authorities of toll payment violations, debits, and participating accounts [7]. The most obvious advantage of this technology is the opportunity to eliminate congestion in tollbooths, especially during festive seasons when traffic tends to be heavier than normal. It is also a method by which to curb complaints from motorists regarding the inconveniences involved in manually making payments at the tollbooths.

2.2 Related literature

2.2.1 Automated vehicle identification

Automated vehicle identification (AVI) is the process of determining the unique identity of a vehicle subject to some form of payment. The majority of vehicle revenue collection facilities record the passage of vehicles through a limited number of collection gates. At such facilities, the task is then to identify the vehicle in the gate area [8].

Current AVI systems should rely on radio-frequency identification, where an antenna at the gate communicates with a transponder on the vehicle via Dedicated Short Range Communications (DSRC). RFID tags have proved to have excellent accuracy, and can be accurately read at highway speeds.

Some systems however, use automatic number plate recognition. Here, a system of cameras captures images of vehicles passing through the specified revenue collection areas, and the image of the number plate is extracted and used to identify the vehicle. This allows customers to use the facility without any advance interaction with the responsible agency. The disadvantage is that fully automatic recognition has a significant error rate, leading to billing errors and the cost of transaction processing (which requires locating and corresponding with

the customer) can be significant. Systems that incorporate a manual review stage have much lower error rates, but require a continuing staffing expense.

As smart phone use becomes more commonplace, some improved road revenue management companies have turned to mobile phone apps to inexpensively automate and expedite payments from the lanes. These apps communicate in real time with the facility transaction processing system to identify and debit customer accounts or bill a major credit card [9].

2.2.2 Automated vehicle classification

Automated vehicle classification is closely related to automated vehicle identification (AVI). Most facilities charge different rates for different types of vehicles, making it necessary to distinguish the vehicles passing through the facility.

The simplest method is to store the vehicle class in the customer record, and use the AVI data to look up the vehicle class. This is low-cost, but limits user flexibility, in such cases as the automobile owner who occasionally tows a trailer [10].

More complex systems use a variety of sensors. Inductive sensors embedded in the road surface can determine the gaps between vehicles, to provide basic information on the presence of a vehicle [11]. Treadles permit counting the number of axles as a vehicle passes over them and, with offset-treadle installations, also detect dual-tire vehicles. Light-curtain laser profilers record the shape of the vehicle, which can help distinguish trucks and trailers.

2.2.3 Transaction processing

Transaction processing deals with maintaining customer accounts, posting payment transactions, and customer payments to the accounts and handling customer inquiries The transaction processing component of some systems is referred to as a "customer service centre" [11]. In many respects, the transaction processing function resembles banking, and several implementing agencies have contracted transaction processing to a bank.

Customer accounts may be post-paid, where payment transactions are periodically billed to the customer, or prepaid, where the customer funds a balance in the account which is then depleted as payment transactions occur. The prepaid system is more common, as the small amounts of most payment makes pursuit of uncollected debts uneconomic. Most post-paid accounts deal with this issue by requiring a security deposit, effectively rendering the account a prepaid one.

2.2.4 Violation enforcement

A violation enforcement system (VES) is useful in reducing unpaid charges, as an unmanned charge collection gate otherwise represents a tempting target for evasion. Several methods can be used to deter payment violators.
A physical barrier, such as a gate arm, ensures that all vehicles passing through the collection centre have paid a charge. Violators are identified immediately, as the barrier does not permit the violator to proceed. However, barriers also force authorized customers, which are the vast majority of vehicles passing through, to slow to a near-stop at the collection centre preferably gate, negating much of the speed and capacity benefits of electronic billing [12].

2.3 Existing and related systems

2.3.1 Automatic Number Plate Recognition (ANPR) System

Automatic number plate recognition (ANPR) is a mass surveillance method that uses optical character recognition on images to read vehicle registration plates. They can use existing closed-circuit television or road-rule enforcement cameras, or ones specifically designed for the task. They are used by various police forces and as a method of electronic toll collection on pay-per-use roads and cataloguing the movements of traffic or individuals.

ANPR can be used to store the images captured by the cameras as well as the text from the license plate, with some configurable to store a photograph of the driver. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. ANPR technology tends to be region-specific, owing to plate variation from place to place.

At the front end of any ANPR system is the imaging hardware which captures the image of the license plates. The initial image capture forms a critically important part of the ANPR system which, in accordance to the garbage in, garbage out principle of computing, will often determine the overall performance.

License plate capture is typically performed by specialized cameras designed specifically for the task, although new software techniques are being implemented that support any I.P.-based surveillance camera and increase the utility of ANPR for perimeter security applications. Factors which pose difficulty for license plate imaging cameras include the speed of the vehicles being recorded, varying level of ambient light, headlight glare and harsh

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