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E-Control of Tankers (Trucks) Movement at Apapa Fuel Lifting Axis in Nigeria

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Abstract: The technology of the internet is utilized to design an intelligent Traffic Management System (TMS) in existing truck transit parks (referred to as Toll gate in this work). The system is designed to effectively control fuel lifting schedule as well as traffic threshold level of trucks and vehicles plying Apapa fuel lifting axis. The system is based on utilizing client-server technology. The system design involves client - server model of computing where client and server communicate over a network. The system has been validated by constructing a prototype application.

Keywords: Intelligent Traffic Management System, Internet, Truck Transit Parks, Client-Server

1. Introduction

The daily movement of vehicles and freights within and outside Apapa, Lagos is becoming more difficult and complex and the limitation faced in altering the transportation infrastructure has led to serious traffic congestion and an increase in the travelling time [1].

The traffic situation in Apapa is a serious cause of concern to road users. The use of Lagos traffic law to restore normalcy within the metropolis has led to no appreciable improvement. According to the new Lagos State Road Traffic Law 2012, trailers, apart from fuel tankers and long buses are now prohibited from plying the roads between 6:00am and 9:00pm [2]. The gridlock along the area directly impacts consignment, time and supply chain system, which have negative impact in the economy [4].

Even though the Lagos traffic law moved to forestall normalcy within the metropolis, the movements of fuel tankers were not restricted by this law and their influx is enormous along Apapa- Oshodi Expressway constituting huge congestion along the axis [3].

Apapa has forty-seven fuel lifting terminals with over 200,000ML in total capacity. Roads serve the important function of ensuring ease of vehicular transportation of people and goods from one location to another. Blockage of roads due to heavy traffic congestion usually leads to degradation of the environment, sustainability issues, reduced quality of life and competitiveness of our cities.

Traffic congestion may be defined as the situation that arises when road networks are no longer capable of accommodating the volume of traffic on them [5].

Apapa is predominantly plied by trucks and tankers due to the presence of sea port and industries. With the increase in urbanization and dependency of Nigeria on importation, Apapa is experiencing a very rapid growth in the number of vehicular flow which has led to serious problems of traffic congestions. This places a greater demand on operating roadway systems with maximum efficiency.

In this work we exploit internet technology to design an intelligent Traffic Management System deployed in existing truck transits parks in conjunction with fuel loading pre-requesting monitored by a server as well as truck traffic threshold level plying Apapa fuel lifting axis; this will reduce traffic congestion in Apapa fuel/product lifting axis.

Intelligent Traffic Management System (ITS) generally describes a wide range of measures and techniques which aims to maximize the usage capacity of the road network. This study employs this approach to solve Apapa fuel lifting axis gridlock.

The intelligent traffic management system proposed in this

paper consists of a server unit and many clients located at different truck/trailer transit parks and interconnected together through the internet.

The server unit stores data from customers and remotely monitor and control the different clients using the internet as the communication backbone, as shown in figure 1.

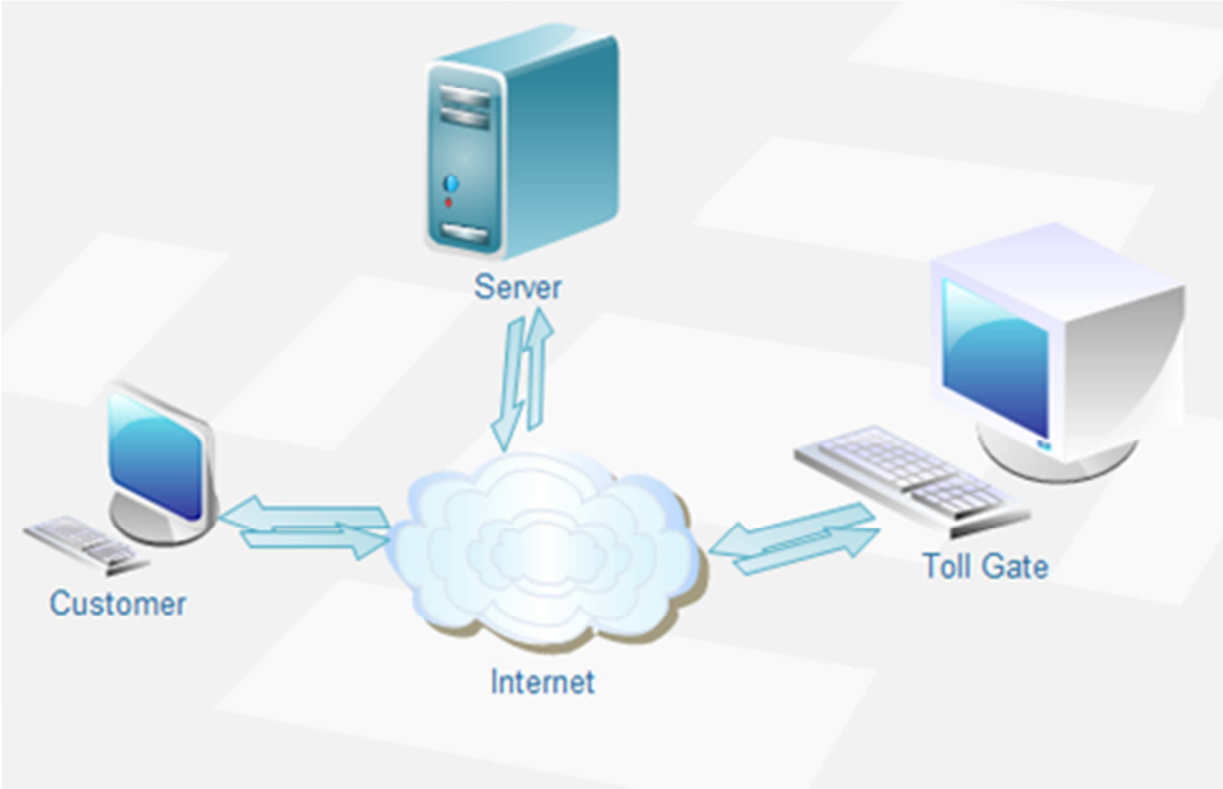

Figure 1. *Web-Based Traffic Management System.*

The reasons for Apapa road traffic congestion were identified in [6]. The reasons include:

I. Indiscreet parking of trucks on road axis
II. Trucks ply the route without being scheduled to lift product
III. Trucks plying overshoot the road thresholds
IV. Dilapidated road infrastructures

This paper is organized as follows: In Section II, we start with literature review and In Section III, we present the proposed traffic management system Methodology followed by the software platforms required to implement the system and its operation in section IV. Discussion of future work and concluding remarks are found in Sections V.

2. Literature Review

Review of Congestion Ameliorative Related Works

Many researchers have dealt with the problem of intelligent traffic monitoring and controlling, and as a result of their efforts several different approaches have been developed.

Author in [7] suggested intelligent traffic management system using embedded web server (EWS) microcontrollers that support well established TCP/IP communication standard with EWS based devices (internet appliances) plugged into an ethernet network. A traffic flow prediction mechanism based on a fuzzy neural network model in chaotic traffic flow time series was presented in [8].

Agent-based fuzzy logic technology for traffic control situations involving multiple approaches and vehicle movements was developed in [9].

The authors in [10] developed an intelligent traffic light control system using hybrid of two standard methodologies: The Structured System Analysis and Design Methodology (SSADM) and the Fuzzy Based Design Methodology; however, this method was only simulated and the system can only be used for four-way junction.

Authors in [11] developed congestion reduction strategy among others such as enhanced transport coordination where coordinating authorities are proposed. This coordinating authority may be appointed by the state or federal government and may have representatives from various stakeholders such as private taxi operators, bus operators, Truck/Tankers, ferry, railways and the government. The key objective should be to attain the integration of different modes of transport to improve the efficiency of service delivery and comfort for commuters. Road Capacity Expansion and Drivers' enlightenment

A low-cost sensor network instrument for monitoring traffic in a work zone was designed and tested in [12]. The authors started the project in 2009 and completed it in 2010.

An Intelligent Transport System (ITS) was developed to improve the traffic management and control system on Hong Kong's road network, which is one of the busiest road

networks in the world. This project was started in 2001 and effectively completed in 2010. The project has ensured optimal traffic control by tracking of all the main highways, trunk roads and road tunnels. Agent technology has been implemented in different aspects of the traffic systems such as handling traffic congestion by monitoring the current traffic congestion and providing the optimal route for a vehicle [13-15].

In recent time, researchers have shifted their attention to revolutionizing the model of the Internet of Things [16-19], which resulted in the construction of a more convenient environment composed of various intelligent systems in different domains such as intelligent business inventories, health care, intelligent home, smart environment, smart metering, supply chain logistics, retail, smart agriculture, monitoring electrical equipment, etc. while it is still in the early stage in case of intelligent transportation system with respect to their needs. However, such techniques consume a large amount of bandwidth and energy [20-23].

Authors in [24] developed a framework for Traffic control and stolen Vehicle location. A green wave concept was adopted for Traffic control and RFID innovation was utilized to distinguish stolen vehicle by sending message to Police station with the help of GSM. Diverse RFID labels were used in recognizing the stolen and rescue vehicle.

3. Methodology

In this work, internet technology is explored as one of the ingredients to design an intelligent Traffic Management System (TMS) deployed in existing truck transits parks; in conjunction with fuel loading pre-requesting monitored by a server as well as truck traffic threshold level plying Apapa fuel lifting axis; this will reduce traffic in Apapa fuel/product lifting axis.

The work flow of the paper is divided into three flows: booking and customer flow, Tank farms flow, Transit park entrance and exit flow.

3.1. Booking and Customer Flow

Customers at the comfort of their homes or offices make an electronic request specifying product, capacity, driver details, tank farm/destination and period to load the products. A one-day grace period after the specified date is automatically generated with other details recorded on the server.

The request from customer is accepted or declined based on the availability of parking pool of the destination. If no space exists at the parking pool as at when the customer made the request; the order will be declined and advised to try the following day. Otherwise, it is accepted with a reference number generated and printed out with a sms sent to the specified phone number. The parking pool availability is a function of total parking capacity the tank farm/destination can accommodate within 24hrs. Each tank farm/destination supplies this information.

3.2. Transit Parks Entrance

The customer approaches toll gate within the grace period otherwise the server automatically flags the vehicle detail with its details deleted. The customer is charged for traffic offence and his request deleted from the system; he will have to start the processing all over again.

If customer is within the grace period, the server accepts the details followed by a check of its threshold of trucks on the route. If within the threshold, it accepts and registers it as one of details of vehicles on the Apapa axis road network. The server immediately calculates expected time limit to reach the destination from the toll gate. The server flags an alarm with the details of the driver if the time elapses without the driver registered received at the tank farm/destination. A rescue team is then deployed calling the driver to salvage any issue on ground.

3.3. Tank Farm/Destination Flow

The truck on getting to the tank farm/destination presents the printed barcode; this is read with a barcode scanner with the information sent to the central server; the central server immediately removes the details as one of the trucks on the axis road network.

The truck on leaving tank farm/destination; the server checks its threshold of vehicle or if the information sent from exit toll gate to delay trucks at tank farm/destination. If within the specified value and condition, the vehicle registered as one of the trucks on the exit route. Otherwise, the server flags alarm at the exit toll gate and it generates a delay time for the truck. The toll gate overrides the alarm after a check of no congestion along the route. The truck later re-presents the barcode after the generated delay time. An expected time to reach the exit toll gate is immediately generated. The server immediately calculates expected time to reach toll gate with a grace period and this is generated.

3.4. Toll Gate Exit

The truck on getting to the exit toll gate presents the barcode; the server accepts the details and deletes the transaction with a slip printed with all the details of the journey transaction.

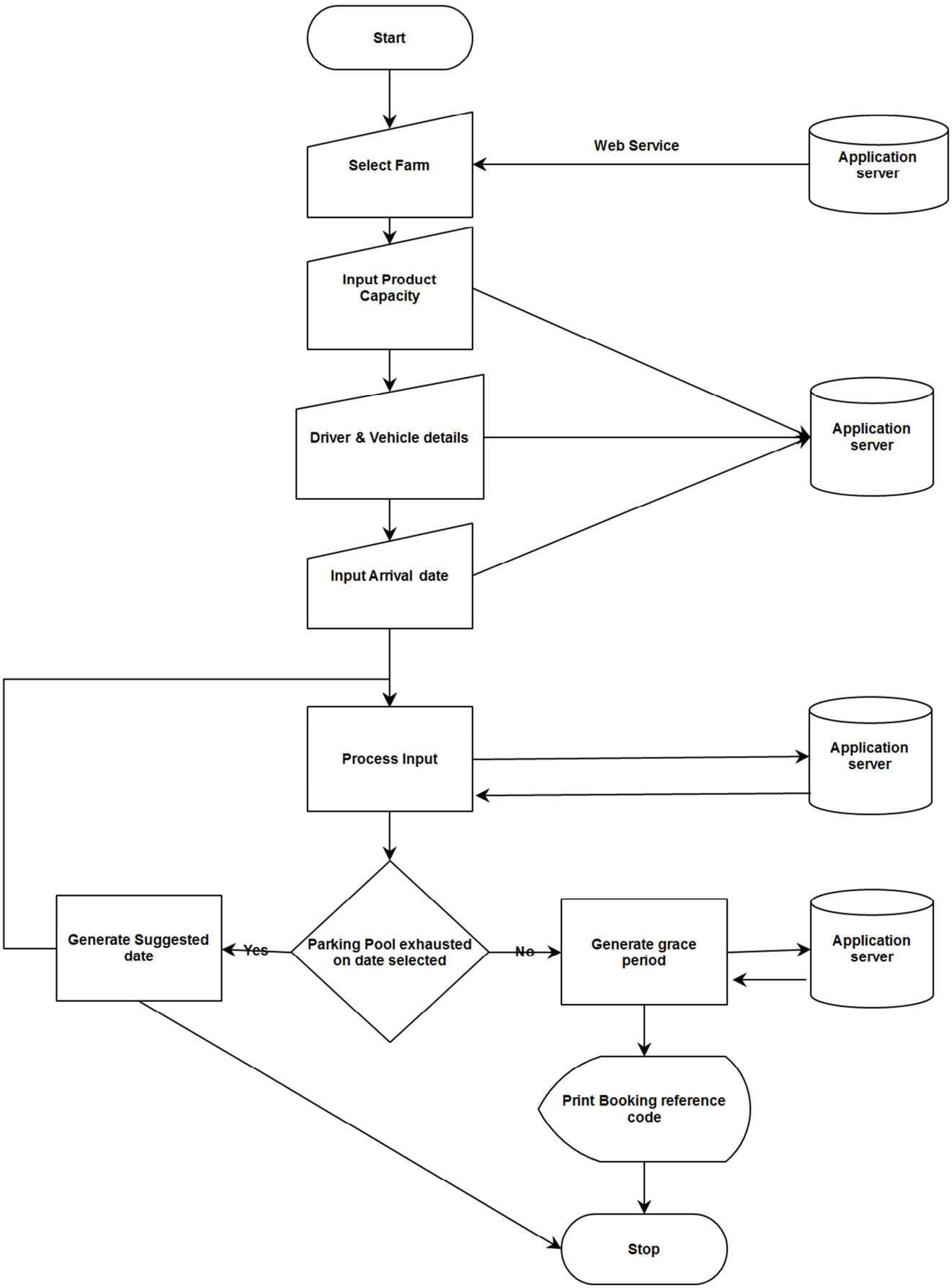

Figure 2. *Booking and Customer flowchart.*

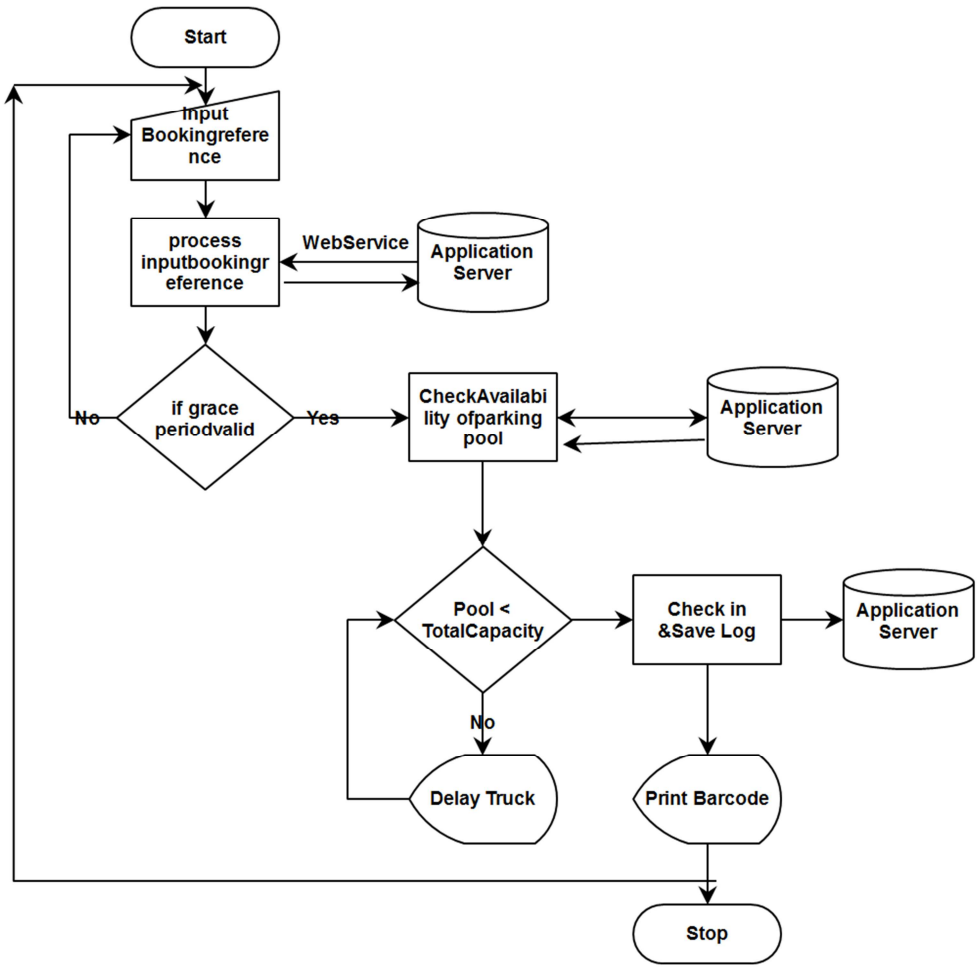

Figure 3. *Truck transit park entrance Flowchart.*

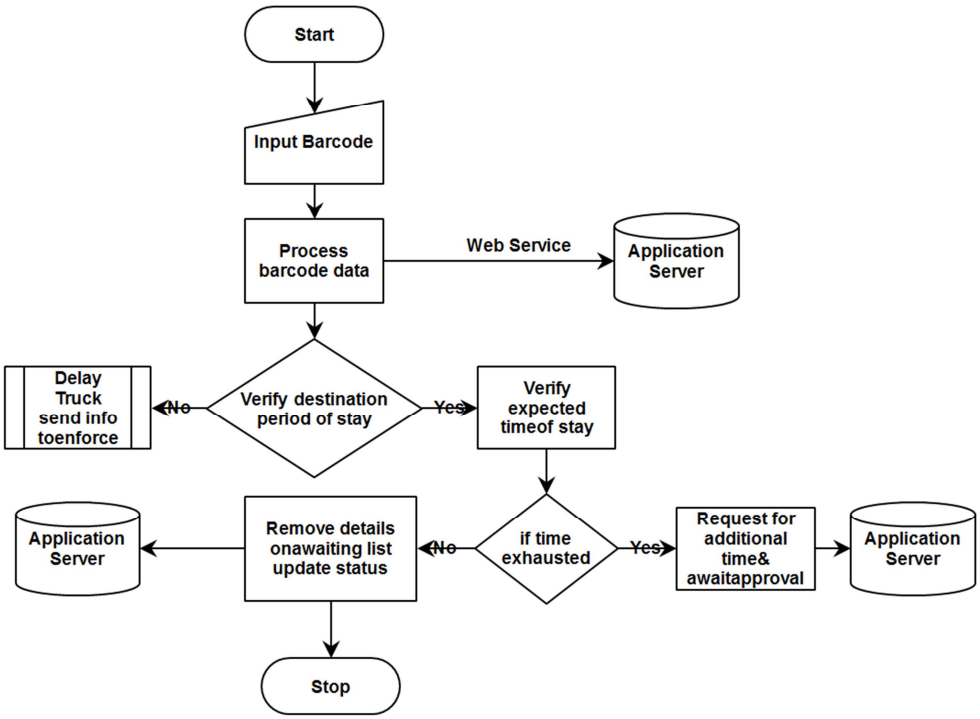

Figure 4. *Tank Farm/Destination flowchart.*

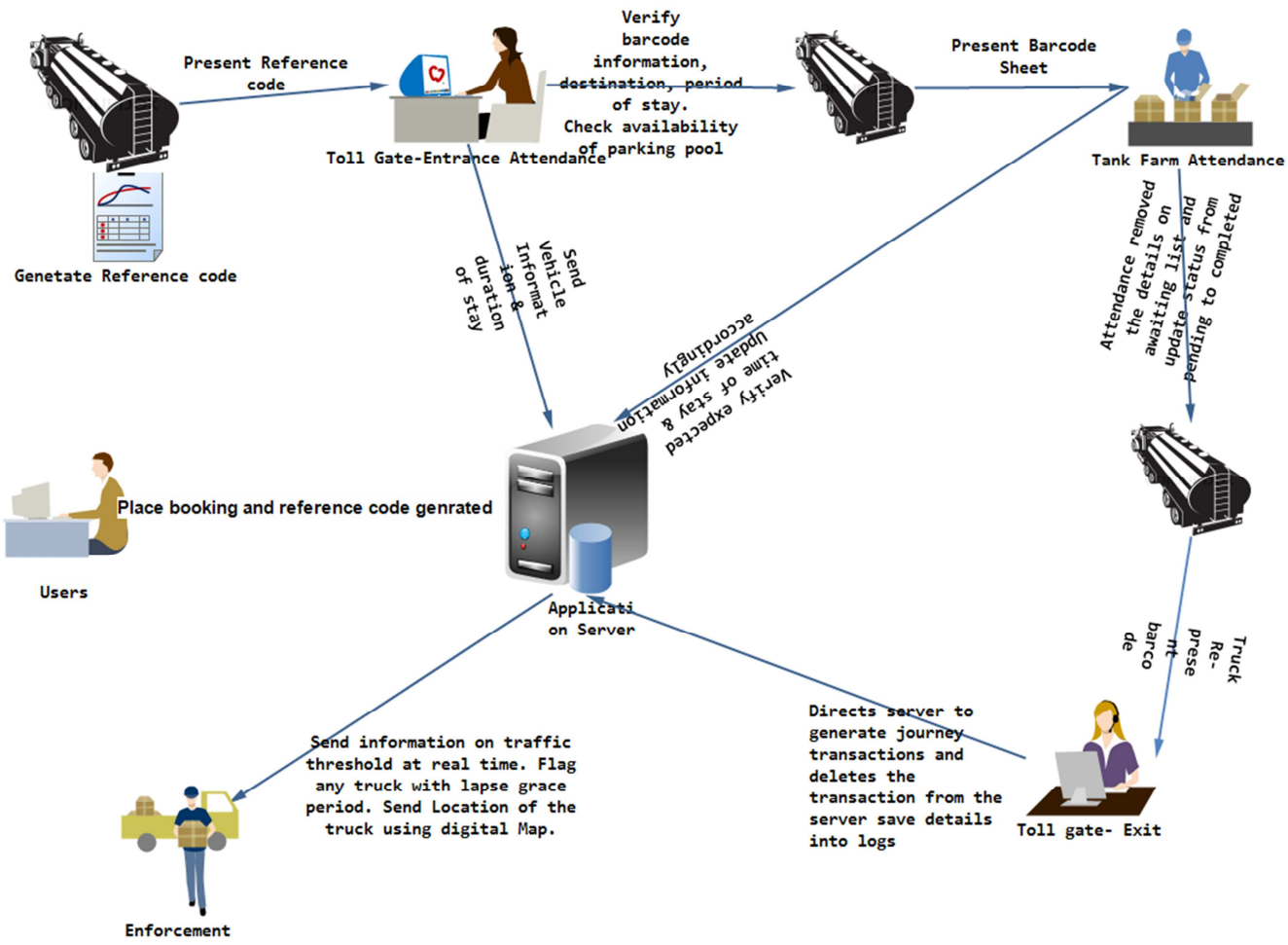

Figure 5. *Pictorial summary of methodology deployed.*

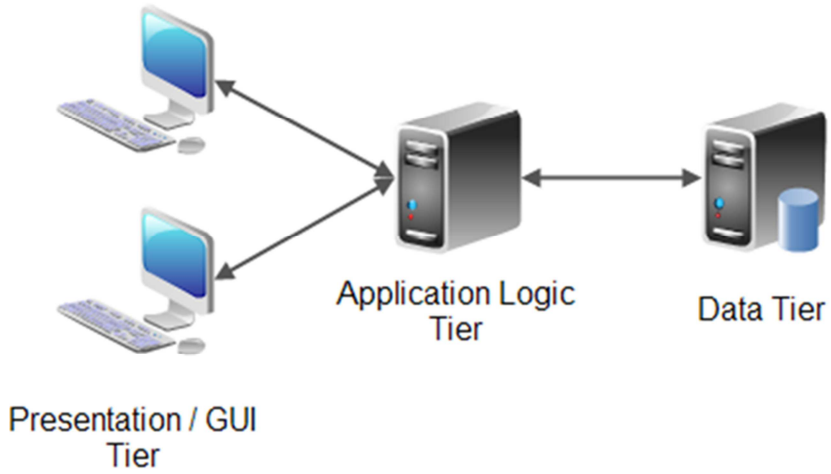

Figure 6. *System Architecture Design.*

4. System Implementation and Operation

System Architecture Design

It is a multi-tier architecture (often referred to as n-tier architecture); a client–server architecture in which presentation, application processing, and data management functions are physically separated as shown in figure 6. Presentation GUI tier is the Econtrol Clients (gate, tank farm etc); the application logic tier makes all the application decisions (This is the web service) and Data Tier (The SQL server).

4.1. Choice of Language

The application Server was built Using WCF (Window Communication Foundation) -C#.

Windows Communication Foundation (WCF) is a framework for building service-oriented applications (SOA). Using WCF, you can send data as asynchronous messages from one service endpoint to another using appropriate service binding. A test Client was built using VB.Net Window Form as Desktop Application.

4.2. Barcode Generation

A bar-code is an optical machine-readable representation of data. Barcode scanners are built from a fixed light and a single photo-sensor, it decodes by manually "scrubbed" across the barcode. (Wikipedia).

A barcode system can provide detailed up-to-date information. Barcode can be linear (1D barcode), 2D barcodes. A Linear Barcode was used.

4.3. Reference Number Generation

Reference number is a unique identification number. It's numeric and unique.

5. Conclusion

The intelligent traffic management system proposed in this work is a robust system that offers a low-cost solution to Apapa traffic management. As future work, we will be considering techniques for optimizing the method and taking other products within the horizon into consideration.

In conclusion, while many thinks improving a country's transportation system solely means building new roads or repairing aging infrastructures, the future of transportation lies not only in concrete and steel, but also increasingly in proper deployment of information technology.

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