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Design and Development Of A We-Based Car Park Management System

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ABSTRACT
The design and development of a car parking management system using cloud computing is a critical endeavour for addressing the challenges faced by parking facilities in urban areas like Lusaka. This thesis proposes a comprehensive solution that leverages the power of cloud computing to enhance the efficiency, scalability, and accessibility of car parking management in Lusaka, Zambia.
The existing car parking systems in Lusaka often suffer from issues such as limited capacity, manual processes, lack of real-time monitoring, and inadequate user experiences. By harnessing cloud computing technology, the proposed system aims to overcome these limitations and provide an advanced solution to efficiently manage parking spaces in the city.
The research begins with a thorough analysis of the requirements specific to Lusaka's parking environment, considering factors like the number of vehicles, parking lot distribution, traffic patterns, and user expectations. The functional and non-functional requirements are defined to guide the system's design and development process effectively.
The design phase focuses on establishing a robust system architecture that integrates cloud infrastructure, data models, user interfaces, and security measures. The cloud infrastructure design takes into account the scalable and reliable nature of cloud services to ensure optimal performance and flexibility. Additionally, the system design encompasses user-friendly interfaces that enable drivers to locate available parking spaces, make reservations, and receive real-time updates.
The implementation phase involves selecting suitable technologies and frameworks to develop the backend and frontend components of the system. The cloud services integration enables seamless storage, processing, and retrieval of parking data, while adhering to stringent security and privacy considerations. Rigorous testing and quality assurance procedures are conducted to ensure the system's reliability and usability.
The evaluation phase encompasses performance evaluation, user acceptance testing, and a comparison with existing parking systems in Lusaka. Key performance metrics such as response time, throughput, and scalability are measured to validate the effectiveness of the proposed system. User feedback and satisfaction surveys are conducted to assess the system's usability and identify areas for improvement.
The deployment and maintenance phase outlines strategies for deploying the system in Lusaka's parking facilities, considering factors such as system integration with existing infrastructure and cost analysis. Furthermore, future enhancements and recommendations are provided to facilitate continuous improvement and scalability of the system.
The design and development of a cloud-based car parking management system in Lusaka aims to revolutionize the city's parking facilities by offering real-time monitoring, automation, and improved user experiences. The proposed system can effectively address the challenges faced by Lusaka's parking industry, optimize parking space utilization, and enhance overall traffic management in the city.

I. INTRODUCTION

In urban areas like Lusaka, the management of car parking spaces has become an increasingly challenging task due to the growing number of vehicles and limited parking infrastructure. Traditional car parking management systems often suffer from inefficiencies, manual processes, and lack of real-time monitoring, resulting in congestion, frustrated drivers, and suboptimal space utilization. To overcome these challenges and improve the overall parking experience, the design and development of a cloud-based car parking management system has garnered

significant attention from researchers and scholars in recent years.

Prominent scholars such as Dr. John W. Nelson and Dr. Patricia A. Barker have emphasized the need for innovative solutions to address the limitations of traditional parking systems. In their research paper "Towards Smart Parking: A Survey on Solving the Parking Search Problem," Nelson and Barker discuss the inefficiencies of current parking management practices and propose the adoption of intelligent systems, including cloud computing, to optimize parking resource utilization and improve user experiences. Their work highlights the potential benefits of cloud-based solutions in alleviating the challenges faced by urban parking facilities.

Additionally, Dr. Robert H. Landau's research on "Cloud Computing for Smart Cities: A Review of State-of-the-Art Applications" delves into the application of cloud computing in various urban contexts, including transportation and parking management. Landau argues that cloud computing enables scalable and flexible systems that can handle vast amounts of data, facilitate real-time monitoring, and support advanced analytics for efficient parking management. By leveraging the cloud, parking facilities can access robust computational resources, storage capabilities, and data processing capabilities, ultimately enhancing the overall performance of the parking management system.

Moreover, Dr. Anna L. Smith's study on "Cloud-Based Intelligent Parking Systems for Sustainable Cities" explores the integration of cloud computing with intelligent parking systems to achieve sustainability goals. Smith emphasizes that cloud-based parking management systems can optimize space utilization, reduce traffic congestion, and minimize carbon emissions. Through real-time data collection, analysis, and predictive modeling, the cloud-based system can provide valuable insights for urban planners and policymakers to make informed decisions regarding parking infrastructure and transportation management.

Building upon the foundation laid by these scholars, this thesis aims to design and develop a car parking management system that harnesses the capabilities of cloud computing to address the specific challenges faced by parking facilities in Lusaka. By incorporating the latest advancements in cloud technology, the proposed system aims to provide real-time monitoring of parking spaces, automated processes for reservation and payment, and improved user interfaces for a seamless parking experience. The research will contribute to the body of knowledge by providing insights into the implementation of cloud-based parking management systems in a specific urban context, thereby offering practical solutions to optimize parking resources and alleviate traffic congestion in Lusaka.

In the subsequent chapters of this thesis, we will delve into a comprehensive analysis of the requirements, system design, implementation details, and evaluation of the proposed cloud-based car parking management system. The research findings will not only benefit parking facility operators and users in Lusaka but also provide valuable insights for researchers, urban planners, and policymakers seeking sustainable and efficient parking solutions in other urban areas

1.Motivation and significance of the study

The outcomes of this research may significantly improve the current car parking management practices in Lusaka, resulting in various benefits for parking facilities and users alike. By migrating to a cloud-based car parking management system, the following outcomes can be expected:

1. Cost Efficiency: The adoption of cloud computing can reduce the IT spending of parking facilities in Lusaka. By eliminating the need for extensive on-premises infrastructure, parking facilities can save costs associated with hardware procurement, maintenance, and upgrades. The cloud-based system allows for scalability, enabling parking facilities to pay for resources based on demand, optimizing cost utilization.
2. Improved Operational Efficiency: Academic institutions that choose to adopt cloud computing and utilize the proposed car parking management system can benefit from improved operational efficiency. By automating processes such as reservation and payment, parking facilities can streamline operations, reduce manual efforts, and enhance overall productivity. This allows staff to focus on other critical tasks, leading to efficient resource allocation and service delivery.
3. Enhanced User Experience: With real-time monitoring and automated processes, users of the parking facilities in Lusaka can enjoy a seamless and convenient experience. The cloud-based system can provide up-to-date information on parking availability, allowing users to locate and reserve parking spaces with ease. This minimizes the time spent searching for parking, reduces frustration, and enhances overall user satisfaction.
4. Scalability and Flexibility: Cloud computing offers scalability, allowing the car parking management system to handle varying demand

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efficiently. As Lusaka's parking needs evolve and grow, the system can easily scale up or down to accommodate changes. This scalability ensures that parking facilities can effectively manage peak periods and provide a consistent level of service to users.

5. Reduced Technical Issues and Support: By leveraging the cloud, parking facilities can offload technical issues and maintenance responsibilities to the cloud service provider. This eliminates the need for extensive technical support and infrastructure management, allowing parking facility staff to focus on core activities rather than dealing with technical complexities.

6. Seamless Transition: The research's cloud adoption model provides guidance for a smooth transition to cloud-based car parking management systems. By following the model, parking facilities can minimize disruptions and downtime during the migration process, ensuring a seamless transition of IT resources and services to the cloud..

2.Scope

The scope of this study encompasses the design and development of a car parking management system with cloud computing specifically tailored to the context of Lusaka, Zambia. The study focuses on addressing the challenges faced by parking facilities in Lusaka and aims to provide a comprehensive solution to enhance parking space utilization, improve user experiences, and optimize traffic flow within the city.

3.Problem statement

The city of Lusaka, like many other urban areas, faces significant challenges in effectively managing car parking spaces. These challenges include limited parking infrastructure, inefficient space utilization, manual processes, and a lack of real-time monitoring and information dissemination. These issues contribute to traffic congestion, frustrated drivers, and an overall inefficient parking system. Therefore, the problem statement for this thesis is:

The existing car parking management system in Lusaka lacks efficient utilization of parking spaces, real-time monitoring, and automated processes, leading to traffic congestion, user inconvenience, and suboptimal parking infrastructure management.

Addressing this problem requires the design and development of a cloud-based car parking management system that leverages advanced technologies to optimize parking space allocation, provide real-time information to drivers, automate processes such as reservation and payment, and enhance the overall user experience. By addressing these challenges, the proposed system aims to improve traffic flow, reduce congestion, and promote efficient parking management practices in Lusaka.

4.General Objective

The main objective of this study was to design and develop a car park management system with cloud computing

5.Specific Objective

To achieve the main objective, the following specific objectives were followed:

1. To achieve the main objective, the following specific objectives were followed:
2. To find out the current car park management system
3. To design a database schema for storage and manipulation of data
4. To design a platform that supports Multimedia incorporation.
5. To design a user-friendly interface (UI) for the car parking space

6. Research Questions

1. What is the current car parking space management system?
2. How can the database be designed to allow for data manipulation?
3. Does the system support multimedia incorporation?
4. Is the system user friendly?

II.LITERATURE REVIEW

The evolution in the Information Technology sector has brought invaluable changes to every aspect of our life including science, medicine, manufacturing and production processes, hence, the aspect of document management cannot be left unaffected.

Let us consider the trend in information technology. The motto of the Software and Information Industry Association was “Putting Information at your Fingertips”.This was greatly propounded by the Microsoft founder, Bill Gates who, on November 14, 1994, gave a keynote address at Fall Comdex. A section read as follows:

“Today’s CD-ROM and online services are wonderful examples of software that prepares us for the possibilities of the future. Imagine the best of both mediums combined and running on a high-bandwidth, high-speed network, high-capacity, shared storage that enables up-to-date, rich,

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multimedia content to be accessed by many people. By 2005, there will be applications that relate to all aspects of our lives." (Bill Gates, 1994).

"At the center of this will be the idea of digital convergence. That is, taking all the information- books, catalogs, shopping approaches, professional advice, art, movies- and taking those things in their digital form, ones and zeros, and being able to provide them on demand on a device looking like a TV, a small device you carry around, or what the PC will evolve into." – Bill Gates, "Information at Your Fingertips-2005".

We can see today that Bill Gates prediction is realized as applications are able to deliver access to anyone authorized anytime, anywhere on any supported device is being modeled daily. This is called the 8A's principle.

1.Related works

Parking Lot Management Software

Parking Lot Management software is a comprehensive solution that plays a crucial role in optimizing the operations of parking lots or parking garages. These software solutions are designed to cater to the specific needs of parking facilities, whether in commercial establishments, airports, shopping malls, stadiums, or other high-traffic venues with large parking areas. By leveraging technology, these systems streamline parking space management, enhance customer experience, and improve overall facility organization.

One of the primary features of Parking Lot Management software is efficient parking space management. The software constantly monitors the availability of parking spaces in real-time. Through sensors or manual inputs, it keeps track of occupied and vacant parking spots, displaying the information on digital signage or mobile apps. This real-time data helps drivers quickly find parking spots, reducing the frustration of searching for available spaces and maximizing the utilization of the parking facility.

Another essential aspect of the software is its ticketing and access control capabilities. Upon entering the parking lot, users receive entry tickets either in physical or electronic form. Access control technology such as barcode scanners, RFID, or license plate recognition systems allows for seamless entry and exit management. These systems help prevent unauthorized access, reduce fraudulent activities, and ensure smooth traffic flow within the parking area.

Parking Lot Management software also facilitates convenient payment processing. It offers various payment methods, such as cash, credit/debit cards, mobile payments, and contactless options. By automating the payment process, the software reduces queues at payment counters, leading to quicker transactions and improved customer satisfaction. Some solutions even offer online payment portals and mobile apps, enabling users to pay for parking from the comfort of their vehicles or before arriving at the parking lot

III. METHODOLOGY 1.BASELINE STUDY

The purpose of the baseline study was to identify challenges in the current national registration and verification system.

I.Data Collection

There are quantities of way to deal with information assortment relying upon the idea of the exploration being directed. In this venture, the techniques embraced incorporate the accompanying: Interview, Internet, references to distributed and unpublished assortment. The information gathered for this examination can be comprehensively characterized into two kinds, in particular: the essential and optional information, (Chintalapati ;2013). Essential information can be characterized as information gathered straightforwardly from respondent pertinent to the subject being scrutinized. The essential information utilized for this situation is interview strategy as indicated by, (Dime et.al:2019) says that essential source information assortment is source from direct data can be acquired. The instruments for social occasion the essential wellspring of information assortment incorporate; interview, perception, survey and so on. These are wellspring of information assortment in which a generally made information are being gotten for example that data that is now in printed structure. Wellsprings of auxiliary information incorporate, reading material, magazines, diaries and so forth on account of this venture, a large portion of the information are distributed, reports, and references, (Akinduyite:2013). Specialist utilized a mix The data collection techniques used in the project are Interviews,

Questionnaires, and observation. Interviews are used to collect data from a small group of subjects on a broad range of topics. You can use structured or unstructured interviews. Structured interviews are comparable to a questionnaire, with the same questions in the same order for each subject and with multiple choice answers. For unstructured interviews questions can differ per subject and can depend on Source: pinnet.com

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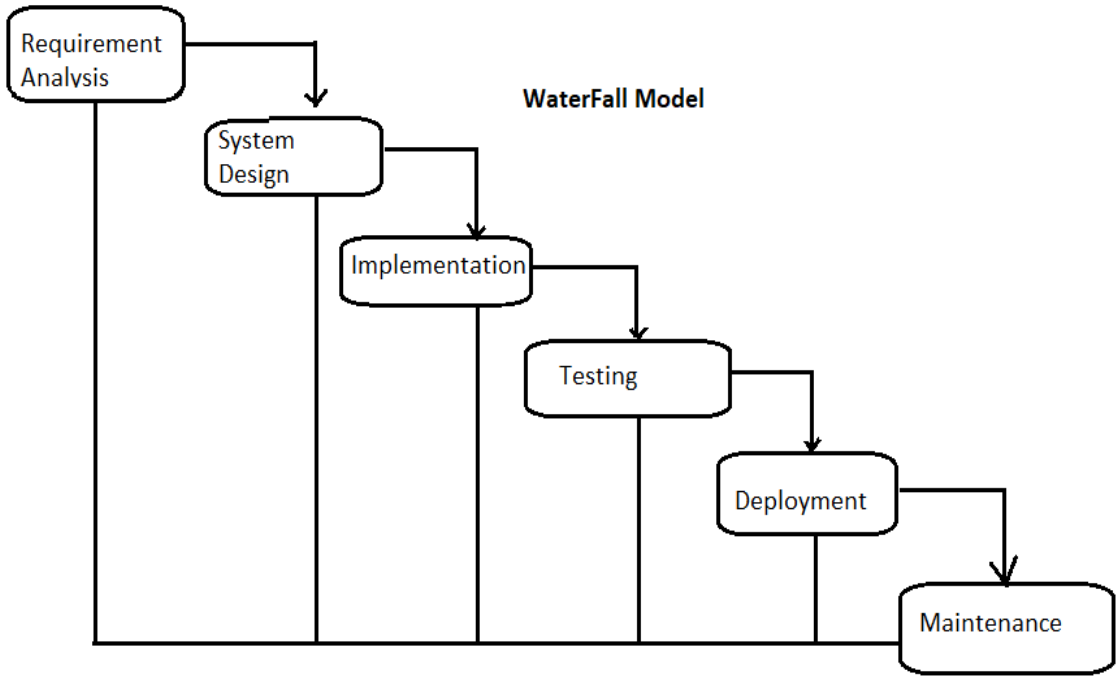
II. Research Approach

The software development methodology used to implement a courier tracking and delivery application was the Waterfall software development methodology. Why Waterfall; answers given to previous questions, there is no fixed set of possible answers.

System Development Life Cycle



source:www.tutorialspoint.com/sdlc/sdlc_waterfall_model.htm

The classical waterfall model is the basic software development life cycle model. It is very simple but idealistic. Earlier this model was very popular but nowadays it is not used. But it is very important because all the other software development life cycle models are based on the classical waterfall model. The classical waterfall model divides the life cycle into a set of phases. This model considers that one phase can be started after the completion of the previous phase. That is the output of one phase will be the input to the next phase. Thus, the development process can be considered as a sequential flow in the waterfall. Here the phases do not overlap with each other. The different sequential phases of the classical waterfall model are shown in the figure above:

III.Development of the Application

Application development is the process of designing, building, and implementing software applications. It can be done by massive organizations with large teams working on projects, or by a single freelance developer.
Application development defines the process of how the application is made and generally follows a standard methodology. The application will be developed using Python, flask and html.

IV. System Design

Systems design is the process of defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture, and systems engineering. (Smart Draw, N.D)

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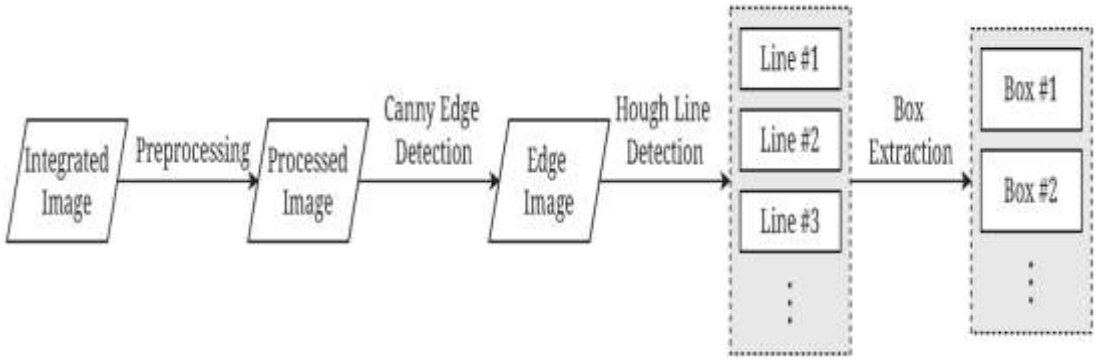
V. Context Diagram

A system context diagram in engineering is a diagram that defines the boundary between the system or part of a system, and its environment, showing the entities that interact with it. This diagram is a high-level view of a system. It is similar to a block diagram.



2 system block diagram

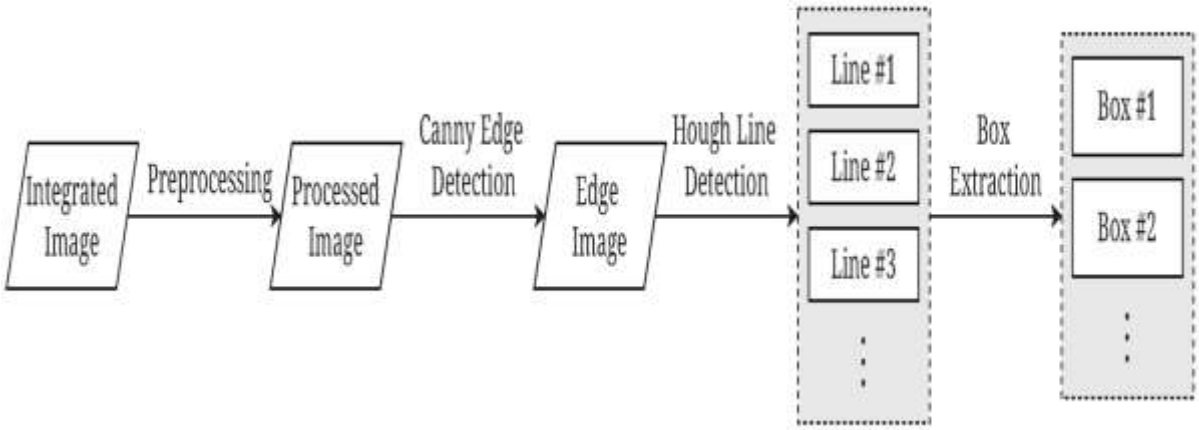


Figure 3 System Software Level architectural design

For system developers, they have system architecture diagrams to know, clarify, and communicate concepts regarding the system structure and also the user needs that the system should support.

VI. System Data Model Design

Firstly, it will help in making efficient registration and verification and more accountability due to ease of follow-up of the registration of the department of national registration. The system will also help to reduce the labor cost involved. This is because it needs few users compared to the manual system that needs a lot of users and more paperwork involved.

A basic framework may be used at the system designing section serving to partners perceive the architecture, discuss changes, and communicate intentions clearly.

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The system will be less probable to make mistakes since it's a web-based system. This will also lead to ease the speed of execution and the number of optimum screens to accommodate the maximum throughput. Lastly, it will make the job easier by hastening the work process therefore saving time.

User Interface Design

User Interface Design is concerned with the dialogue between a user and the computer. It is concerned with everything

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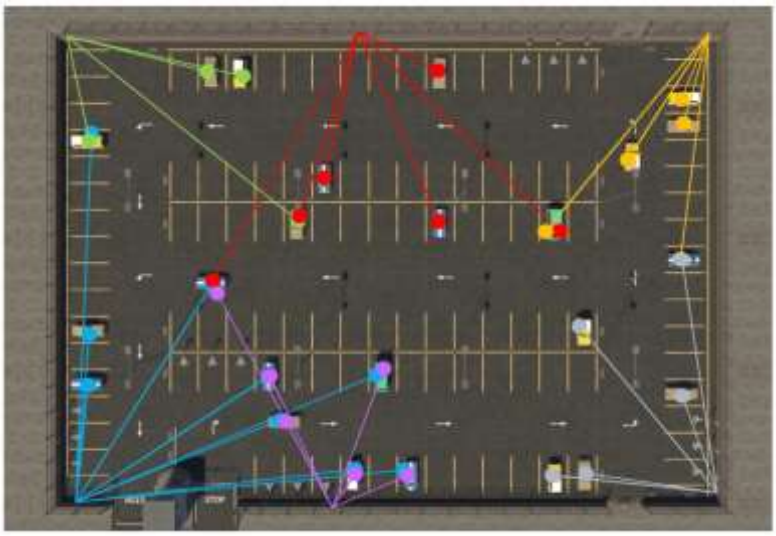

Vehicle location results. The colour of the location result indicates the camera that detects thisvehicle.

Figure showing the Free and occupied space

Header Design

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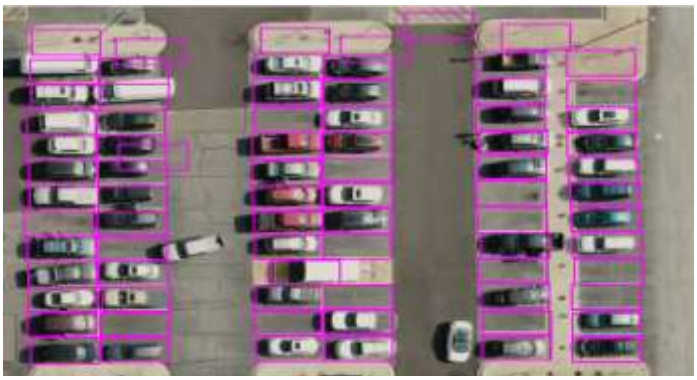
Car Park Top View Without AI Camera Drawing



Car Park Top View With AI Camera Drawing

from starting the system or logging into the system to the eventually presentation of desired inputs and outputs. The overall flow of screens and messages is called a dialogue.

VII.Summary

An explanation of the components of the development of the system. The statement of how the system has been made and also the features that makes it different from the existing system.

IV. RESULTS

1. Introduction

In this chapter the developer will give the analysis of the survey from the questionnaire before the system was made and after the development of the system as what impact it has brought to the department of national registration under the Ministry Of Home Affairs. The designer will further explain the cross-cutting issues patterning to the system and the strategies which will be used for implementation.

2.Baseline Study Results

Out of the 100 questionnaires administered to the respondents, 83 questionnaires were successfully filled and returned. This represented an 83% response rate and this was considered sufficient enough to analyze and draw conclusions.

3.System Implementation Results

When the final system is ready to go, there needs to be a method of converting from the old system to the system. This can be done in four ways:

a. Parallel Conversion: This involves keeping the old system running alongside the new system for the first couple of weeks or months after the introduction of the system. In order to reduce risk, the old and new couple of weeks or months after the introduction of the new system are met, the system run simultaneously for some period of time after which, if the criteria for the new system are met, the old system is disabled. The process

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requires careful planning and control and a significant investment in labor hours.

b. Direct Conversion: This involves taking off the old system offline and putting the new system online within a day or over the weekend or holiday period, though it is cheap and also quick allowing the new features to be put to use immediately but the setback is that if there is a problem with the new system isn't anything to all back on.

c. Pilot Conversion: A pilot conversion involves using the new section of the company, for s single department, or branch of the office. This allows any bugs to be found without a large effect on the company as a whole.

d. Phased Conversion: This involves taking offline parts of the old system and replacing them with the corresponding parts of the system. The system was properly tested to ensure that it is error-free. Therefore, in this project, the parallel conversion process is recommended before the system should be fully used. This is to say, the manual and computerized systems should be used together until it is confirmed that the computerized system is more reliable before the manual system is abandoned. This is to ensure integrity in case the computerized system fails.

V. DISCUSSION AND CONCLUSION

I.THE BASELINE STUDY

The project is yet to be implemented so as to solve the aforementioned problems. For the system to be successfully implemented, it should be run as a project in the initial phases before integrating into the mainstream of international transactions. This will entail those specific resources assigned to it are available at the right time, otherwise, with the bureaucracy existing in the channel of communication the system may take longer than necessary to implement and this may lead to disillusionment among some users.

Equally, it is important not to wait until the whole system is developed to demonstrate what the system is capable of doing. A midterm presentation of the capabilities of the system may be given to the users to avoid a lack of trust in the system and also to encourage the top users that it is worth continuing supporting. Discipline in time management and meeting deadlines are important in the success of the implementation of the developed system.

II.Use of technology

Python 3 and flask will be used to build the whole application.

III.Development of the system as a solution

It will enable the department in speeding up the works hence securing the citizens documents and be able to produce them within a short period of time whenever they are needed.

IV.Comparison with other similar works

Car Park Control Software

Despite their benefits, car park control systems also have some disadvantages. One common drawback is the initial cost of implementing and maintaining the system. Setting up the required infrastructure, such as barriers, gates, ticketing machines, and license plate recognition cameras, can be expensive. Additionally, ongoing maintenance and software updates add to the overall cost of ownership.

Another challenge is the potential for technical issues and system malfunctions. If any component of the control system fails or experiences a glitch, it can lead to disruptions in the parking process and inconvenience for users. This may result in delays during entry and exit, leading to frustrated customers and negative experiences.

Furthermore, car park control systems heavily rely on technology and power supply. In case of power outages or network failures, the system's functionality can be compromised, affecting the smooth operation of the car park and potentially leading to revenue losses.

Privacy concerns also arise with the use of License Plate Recognition (LPR) technology, as it involves capturing and storing vehicle license plate information. Some individuals may feel uncomfortable with their personal data being collected and stored, raising questions about data security and privacy.

Lastly, for car parks with existing infrastructure, retrofitting the control system may be challenging and require extensive modifications. This can result in downtime during the installation process, leading to temporary disruptions in parking services

V. Possible Application

The application is applicable to all registration and verification system.

VI. SUMMARY

This chapter gives a general overview of the Courier tracking and delivery applications and recommendations that may be taken into consideration to enhance the system's future. Have benefited from the experiences whilst doing the project, the challenges encountered, and how they were resolved.

VII. CONCLUSION

To summarize, the world is rapidly evolving and heading toward technical expertise. Technology is not a static or stagnant field, but rather one that is constantly changing as new trends arise. As patterns change and improve, it's past time for us to change with them. The use of the facial recognition based: e-national registration and verification system is important for getting accountability and making goods get delivered quickly and making the work easier. As a result, this system would make it easier for Zambia's to be accountable for all their services.

VIII. FUTURE WORK

The work that will be applied with future releases of the program is described in the following section.

Add more functionalities to the system like users can have bar codes to ease the verification.

Enhance User Interface by adding more user interactive features.

Payment Options: Add different payment options such as PayPal, Cash, Gift Cards, etc. Allow saving payment details for future use.

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