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Development of an Internet of Things Enabled Vehicle Movement Management System for Federal University of Technology Minna

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ABSTRACT

In recent years, the number of cars entering Federal University of Technology Minna has been on the increase. Vehicle Security can be managed using time-in and time-out metrics as well as license plate numbers. This research proposes a way for tracking vehicle movement based on the vehicle's license plate number with a data logging model that serves as a centralized database structure for vehicle identification, employing image processing and IoT for detection and recognition accuracy. This project aims to develop an internet of things enabled vehicle movement management system for federal university of technology Minna using AI, computer vision (image processing), laser scanning, and CNN. This challenge requires mathematical ideas and algorithms to complete the product's steps. High-quality cameras capture the image. This work focuses on plate number localization using contours tracing and optical character recognition using OpenCV modules. A vehicle equipped with a high-precision GPS and GSM module was used to test the suggested video processing technique. This study combines a variety of methods, from plate number detection to character recognition, to increase system performance with minimal effort and processing resources. These trials show the adaptability of Federal University of Technology Minna's vehicle, along with video and image processing for data logging and decision making. Also demonstrated were training data set results and video frame recognition persistence. A graphical user interface was created for data logging to enable model training continuation and system monitoring and control. It is strongly suggested that vehicle investigations benefit from the use of a central, publicly accessible database for license plate number lookup. If police had access to this database, they would have a streamlined method of locating wanted individuals by license plate number. Not only would such a system improve public safety, but it would also be a huge help to law enforcement in their day-to-day activities.

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INTRODUCTION

Given the success of deep learning models in areas as diverse as computer vision and others, it is now considered a state-of-the-art method for addressing machine learning challenges. To categorize or forecast information, machine learning is the use of a set of

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statistical models that have been trained on data sets comprising various attributes [1]. For instance, a weather forecast for a specific day could be generated by training a model using historical weather data [2].

For an intelligent traffic or vehicle management system, the team is working on an image processing based work for Automatic Recognition of Number plate from the image of the vehicle considered. People's interest in high-tech, efficient, and precisely functioning intelligent transportation systems has been on the rise alongside the proliferation of highways and cars in recent years [3]. Due to factors like shifting viewpoints, color-matching between the car and its plate, a variety of different plate forms, and varying lighting conditions outside the car, extracting license plate numbers from vehicle photos is a difficult operation for an IPNR system [4].

Federal University of Technology Minna (FUT Minna) is seeing a daily increase in vehicle traffic, and many residents have a negative attitude toward proposed solutions. Most car crashes are brought on by drivers who are either going too fast or not paying attention [5]. Vehicle identification has become more challenging as a result of people's reluctance to reduce their speed to the legal limit, particularly in school and college zones. There are occasions when it is difficult to identify a car owner who often violates traffic regulations by driving too swiftly. Since traffic officers may have trouble reading a license plate from a moving vehicle, it is impossible to apprehend and punish those who break the law in this way.

In light of this difficulty, it is worthwhile to consider developing an IPNR system for vehicle registrations. Despite this, there are many IPNR systems available now. Though these systems employ a variety of methods, accurately identifying moving vehicles remains challenging due to variables such as vehicle speed, non-uniform vehicle number plates, vehicle number language, and lighting conditions [6].

The IPNR System has many applications, including the detection of speeding vehicles, the control of restricted areas, unattended parking areas, the enforcement of traffic laws, the collection of electronic tolls, etc. Image acquisition, license plate recognition, edge detection, character segmentation, character recognition, and database matching are the main procedures to complete the suggested task. A vehicle's whereabouts at Federal University of Technology Minna can be monitored and determined with the help of vehicle tracking technology. This technology is a comprehensive security and fleet management solution that makes use of satellite and ground-based stations to pinpoint the exact location of a moving vehicle.

A tracking device installed in the car gives precise real-time positioning, and the collected data can be saved and later analyzed on a computer [7]. According to [8], this system is a must-have for any automobile owner who wishes to keep tabs on their vehicle at all times. It has gained widespread acceptance recently and is especially prized by those who drive luxury vehicles. The device incorporates state-of-the-art hardware and software to enable online and offline vehicle tracking and location. Three key components make up a tracking system: the vehicle unit, the base station, and the database and associated software [9].

Federal University of Technology, Minna has had increased security issues due to the inability to detect and monitor vehicle traffic entering and exiting the campus. The

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absence of a centralized database structure for vehicle identification based on plate numbers; and the inability to monitor vehicles based on their plate numbers in the case of a security compromise. Trip duration, stolen car tracking, and unlawful vehicle access are just some of the security applications that rely on this identifier.

The aim of this project work is to develop an internet of things enabled vehicle movement management system for federal university of technology Minna. The following objectives includes: to design a security movement monitoring system that registers vehicle using raspberry pi and vehicle plate number; to integrate a cloud based server to work with the monitoring system; to design web application for vehicle monitoring activities.

REVIEWED LITERATURE

A. *Cloud Based Architecture*

Data logging entails the process of gathering and storing A cloud-based system is made up of a network of interconnected computing and storage servers that act as a single, logical unit to host multiple isolated virtual machines that perform various system tasks, application containers, and computing services [10].

A software system can be made to work on a cloud platform by having it deployed on the platform's virtual machines, although this only has the advantage of removing the need to acquire and maintain physical hardware. Users still need to configure their preferred computing environments on the cloud, including libraries, networks, and storage. Application containers provide interfaces to computing environments, relieving users of the burden of manually configuring those settings for each deployment of system software on a cloud platform.

This system was built using a cloud-based technology called Function as a Service (FaaS). FaaS examples include Amazon Lambda and Microsoft Azure Functions. For high-throughput tasks like data manipulation, modifying, and event detection, users can develop lightweight apps as stateless functions with this set of tools. APIs link FaaS operations with data storage and transfer. FaaS functions are serverless because they are not operated on dedicated servers and are instead priced according to the number of times they are invoked.

B. *Internet of Things (IoT)*

There has been a significant increase in the prevalence of vehicle tracking systems, as reported by [11]. This setup uses an anti-system to keep track of a vehicle's whereabouts using GPS, GSM modules, and a Thing Speak channel in the event that it is stolen. Security for private automobiles, taxis, cabs, school buses/cars, and other vehicles was just one of the many benefits of vehicle tracking systems.

The tracking system's GPS and GSM components allow for quick and easy vehicle location. Using coordinates like latitude and longitude, the GPS module can monitor where the car is at all times. The term "Internet of Things" (IoT) describes a network of interconnected devices that may automatically gather and share information over a wireless connection. An IoT-based, GPS-GSM-based vehicle monitoring system might be built in tandem with a mobile app based on Google Maps to provide license plate-based vehicle tracking. A GPS antenna, GSM modem, Nano microcontroller, and mobile application for vehicle location determination utilizing a web-map are integrated into a single system for straightforward navigation.

GSM modem are mobile phone or gadgets designed to communicate over

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a network with SIM card operated to a computer through serial universal (USB), or Bluetooth connection. The GPS module is used by the vehicle tracking system to obtain geographic coordinates at regular intervals. The vehicle's location is transmitted and updated to a database using the GSM/GPRS module. A Smartphone application is also being developed to track the vehicle's whereabouts in real time.

A vehicle tracking system, according to [12], is an automated technology that makes it easier to find and monitor the position, timing, and movement of a carriage. The writers created a tracking system that incorporates "GPS" and "GSM" technology. It is the simplest and most cost-effective technology for detecting car theft. It's a closed system that uses a GPS receiver and a GSM modem to track the vehicle's location and provide status updates. The location of a GSM modem is displayed in terms of longitude and latitude.

The Global Positioning System (GPS) synchronizes time, speed, and location for a wide range of uses. The global positioning system (GPS) in modern automobiles, smartphones, and wristwatches can be used to track vehicles all over the world using only the vehicle's license plate. The Global Positioning System (GPS) consists of both satellites in orbit around the Earth and ground control stations that relay location information to users.

The ground antenna, ground control stations, and Earth-based monitoring stations make up the control segments. One of its primary functions as a control system is the monitoring, via mobile device, of the sent signal from the satellites it is responsible for following and operating in orbit (cars, watches, smartphones, and telematics devices). Uses for global positioning system (GPS) include pinpointing a specific spot on the map, guiding travelers to their destination, keeping tabs on people or things in transit, drawing up detailed maps of the world, and measuring time with pinpoint accuracy [13].

C. Deep Learning

To function properly, a three-layer neural network requires the use of deep learning, a branch of machine learning. These neural networks try to mimic the human brain by emulating its ability to learn from vast amounts of data, but they currently fall far short of the human brain. Single-layer neural networks can be optimized and improved by adding hidden layers, while multi-layer networks can provide more precise predictions. Deep learning is used by many AI products and services to boost automation by carrying out analytical and physical tasks automatically, without human intervention. Deep learning is used in both already available and soon-to-be released items (including digital assistants, voice-enabled TV remotes, self-driving automobiles, and credit card fraud detection). After that, the deep learning system adapts to the new data by using techniques like gradient descent and back propagation, so it can make more exact predictions when presented with an updated image of the animal.

According to [14], deep learning is well suited for improved analysis and can pick up vast amounts of unlabeled data in many different domains. Automatic speech recognition, image recognition, natural language processing, drug discovery and toxicology, CRM, a recommendation system, and bioinformatics are just some of the areas where deep learning has been put to use. Thus, it is appropriate for use in a public place car monitoring system, such as at the FUT Minna entry gate. [15], looked into the use of Deep Learning to solve some of the most pressing issues in big

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data analytics, including the extraction of complex patterns from large datasets, the standardization of data tagging, the acceleration of information retrieval, and the simplification of discriminative tasks. Due to the proliferation of data collection initiatives in sectors as diverse as national intelligence, cyber security, vehicle detection, fraud detection, marketing, and medical informatics, big data has emerged as a key concept.

The ability of Deep Learning algorithms to extract high-level, complex abstractions as data representations through a hierarchical learning process has made them a useful tool for big data analytics, where the raw data was often unlabeled and uncategorized. Concerns have been voiced about the practicality and widespread adoption of Deep Learning systems, and the complexity of their underlying algorithms has been highlighted by researchers and users [16]. Human-Centered Machine Learning is a new topic that grew out of these worries and the growing number of interactions between humans and artificial intelligence (AI) (HCML). The HCML definition is a working document that was developed in collaboration with domain experts in the field. Conflicting interpretations, pressing problems, and promising avenues for future HCML study were revealed by an examination of the landscape's structure as determined by the identification of research gaps.

CNN is a type of feed forward neural network model. Variations of this network have been successfully applied to several different computer vision problems. CNN use the concept of convolution in order to create an architecture using several layers of convolution and nonlinear activation functions [17]. A property that makes CNN stand out with respect to other neural network model's is its ability to process and find patterns in images [18]. There are several CNN architectures used for object detection. A distinction that is important to note is that there is a difference between network configuration, that is, the number and type of layers used and the network architecture when dealing with object/vehicle detection models. The latter is usually compromised of several CNN's as well as other Machine Learning models to increase detection accuracy and speed.

[19] Investigated on how Deep Learning is being utilized for addressing some important problems in Big Data Analytics, including extracting complex patterns from massive volumes of data, semantic indexing, data tagging, fast information retrieval, and simplifying discriminative tasks. Big Data has become important as many organizations both public and private have been collecting massive amounts of domain-specific information, which can contain useful information about problems such as national intelligence, cyber security, car detection, fraud detection, marketing, and medical informatics. Deep Learning algorithms extract high-level, complex abstractions as data representations through a hierarchical learning process, which has made it a valuable tool for Big Data Analytics where raw data is largely unlabeled and un-categorized.

D. OpenCV

OpenCV (Open Source Computer Vision Library) as a free software library for computer vision and machine learning has the capability to provide a common infrastructure for computer vision applications and to help commercial goods incorporate machine perception more quickly in terms of detection, tracking and object classification.

Also, these algorithms as the ability to detect and recognize faces, identify objects, classify human actions in

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videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, remove red eyes from images taken with flash, follow eye movements, recognize scenery, and establish markers to overlay. More than 2500 optimized algorithms are included in the library, which contains a comprehensive mix of both classic and cutting-edge computer vision and machine learning techniques.

Considering the issues of taking primary information about the technical condition of the object, [20] suggested that, it is necessary to designate computer vision technologies as the main permanent source of data acquisition, and laser scanning as periodic surveys aimed at obtaining and subsequent comparison of three-dimensional models of the construction of various time periods. [21] Discussed on the impact of efficient data which has changed benchmarks of performance in terms of speed and accuracy. Also, computer vision (CV) and artificial intelligence (AI) has enhanced visualization, data processing, and data analysis.

These technology has empowered major tasks such as object detection and tracking for traffic vigilance system. Convolutional neural network (CNN) model is designed for urban vehicle dataset for single object detection and YOLOv3 for multiple object detection on KITTI and COCO dataset. The objects are tracked across the frames using YOLOv3 and Simple Online Real Time Tracking (SORT) on traffic surveillance video. In conclusion the efficient detection and tracking on urban vehicle dataset is witnessed. The algorithms give real-time, accurate, precise identifications suitable for real-time traffic applications

The implementation of a centralized database server for vehicle monitoring with the development of an internet of things enabled vehicle movement management system for Federal University Of Technology Minna is discussed in the subsequent section.

METHODOLOGY

To get the intended outcome, it is essential to use the proper system design materials, procedures, commands, and algorithms. Artificial intelligence in vehicle location detection and management systems finds application in the transportation industry, where vehicles can be located across many regions using CNN, computer vision, optical character recognition, and internet of things (IoT) mechanisms as its approaches for developing an internet of things enabled vehicle movement management system with a data recording model that serves as a centralized database structure for vehicle identification.

E. Materials

The research employs a variety of programming languages and software libraries, including OpenCV, Optical Character Recognition (OCR) Technology, Proteus, Python, Hypertext Markup Language (HTML), and Cascading Style Sheet (CSS). The hardware components of the study consist of a Raspberry Pi 3 Model B+ and a Pi Camera.

OpenCV utilizes image analysis and recognition to unveil concealed text through OCR. Proteus, with its virtual environment for circuit design and simulation, provides a safe space for experimentation and testing. Python serves as the versatile backbone of the project. Meanwhile, HTML and CSS work together harmoniously to create the visual presentation of the research.

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The Raspberry Pi 3 Model B+ and Pi Camera form the hardware of this project, with the former serving as the powerful engine behind the study and the latter providing a clear and precise lens for capturing the world. Together, these technologies combine to produce a remarkable masterpiece of innovation and knowledge.

F. Methods

The following are the methodology employed for this system development.

i. Design of remote security monitoring scheme for the Federal University of Technology vehicle system

The remote security monitoring system utilizes a raspberry pi 3, Pi Camera, and GPS module. Ubuntu was uploaded to the device to run the raspberry pi and pi camera. This section covers image acquisition, image processing, and monitoring architecture. Image acquisition is getting a Pi camera image. First step of any vision-based system. A digital camera is put up along the road and pointed towards oncoming cars for this project. License plate numbers are sought. The remaining phases are unavailable. After gathering the original image, derive the grayscale. Grayscale pseudo codeOpen picture; Get the image's width, height, and channels; Pointer to image data; Manually convert the image's heights and widths to grayscale by averaging the r, g, and b channels; Display the gray scaled image.

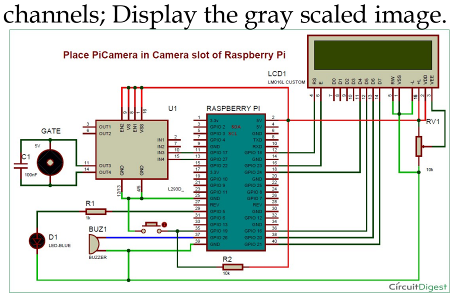

Figure 1: Circuit of remote security monitoring for the Federal University of Technology vehicle system

a. Character Segmentation

Automatic number plate recognition relies on segmentation for all subsequent phases. If segmentation fails, a character may be erroneously split or combined. We can segment a number plate using a horizontal projection or neural networks. This segmentation uses two types: Segmentation horizontal Segmentation vertical. First, we segmented the number plate, then the characters. After vertical segmentation, horizontal segmentation is needed to acquire plate characters.

b. Character Recognition

Character recognition requires feature extraction. Feature extraction converts bitmap data into computer-friendly descriptions. Character recognition should be independent of font type or skew. All characters should be described similarly. Character descriptions are numerical vectors called descriptors or patterns.

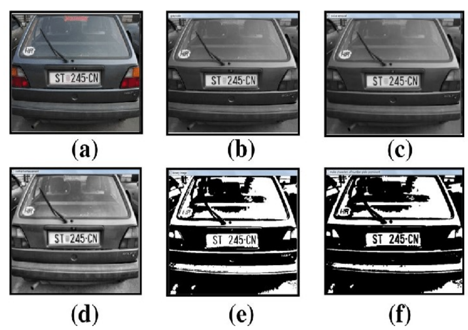

Figure 2: Preprocessing steps for an image: a input RGB image, b gray scale image, c noise removal, d contrast enhancement, e binary image, f dialated image

ii. Design of centralized database architecture for vehicle monitoring and control in Federal University of Technology Minna.

a. Python

Python offers automatic memory management in addition to object-oriented, imperative, functional, and

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procedural programming styles. Python is therefore a better choice for creating the suggested car monitoring system with data logging capabilities. Number plates are identified using OpenCV, then letters and digits are extracted from them using Python Pytesseract. The endpoint for connecting Firebase with the car monitoring system is the Python Request Library, which outputs the data to the monitoring system's graphical user interface. The graphical user interface for the vehicle monitoring system is built using Python on the back end.

b. MySQL

The MySQL system is distinctive in that it guarantees perpetual uptime and offers a wide range of configurations, including slave/master replication settings and special cluster servers. MySQL is a relational database management system (RDBMS), and it would be used to store the real-time data obtained from the footage of the license plate number of the vehicle by the camera. MySQL has the ability to store records in multiple, separate, and highly codified tables rather than a single repository.

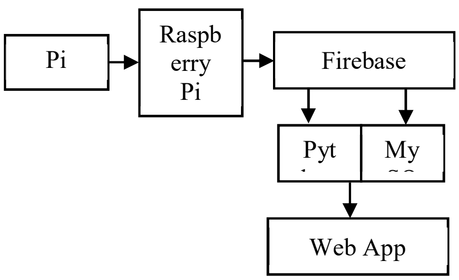

Figure 3: Design of centralized database architecture for vehicle monitoring system.

C. MySQL

TheReact, a JavaScript library, can be used in web development to build user interfaces. It's component-based architecture and virtual DOM make it well suited for developing complex and dynamic web applications.

In the context of developing an IoT enabled vehicle movement management system for Federal University of Technology Minna, React is used to build the frontend of the system. It can be used to create a user-friendly interface that allows users to view the current status of vehicles, track their movements, and manage their movement by performing operations such as starting, stopping, and controlling their speed. By using React, and taking advantage of its fast performance, reusable components, and a large community of developers to make the development process more efficient and easier.

iii. Design of data logging and storage scheme with graphical user interface for Federal University of Technology vehicle control system

a. Cloud Services

Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android and web apps. This system considers using the firebase technology for the following. Google Analytics for Firebase gives free, unlimited reporting on 500 events. Analytics shows user activity in web apps to improve vehicle monitoring system performance. Firebase Authentication makes developing secure authentication systems easier and improves user sign-in and onboarding. Cloud messaging – Firebase Cloud Messaging (FCM) – is a free cross-platform messaging technology for web apps. Realtime database is a cloud-hosted NoSQL database that syncs data in real time. The data is synchronised across all clients in real time and available offline. Firebase Crashlytics Crashlytics tracks, prioritizes, and fixes app stability issues in real time. Crashlytics helps agencies organize and troubleshoot web app problems. It

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improves system performance. Test lab allows cloud-based app testing. Agencies may test web apps across devices and configurations with one action. Firebase console shows videos, images, and logs.

b. HTML and CSS

The HyperText Markup Language (HTML) is responsible for providing the web app's content with structure and meaning. While Cascading Style Sheets (CSS) is a presentation language for designing the appearance of information, such as fonts and colors, XML is a markup language used for structuring the data that makes up web pages. HTML provides the structure of the page, and CSS provides the layout (both visually and aurally) for a variety of different devices. In addition to coding and pictures, HTML and CSS are the fundamental building blocks that go into the creation of web pages and web apps. As a direct consequence of this, the front end building of the graphical user interface activities for the vehicle monitoring system is carried out using HTML and CSS.

RESULTS AND DISCUSSION

The result for this research is sub-divided into three categories, and this is discussed as follow:

G. Result and discussion of a remote security monitoring scheme for the metropolitan vehicle.

The development of the Internet of Things (IoT) enabled vehicle movement management system for the Federal University of Technology Minna was a successful and innovative project. The system was designed to improve the efficiency of vehicle movement management at the university by utilizing the latest IoT technology. The system was developed with a range of features that allows for real-time monitoring and control of vehicle movement, including GPS tracking, automated notification and reporting, and secure data management. This has resulted in improved accuracy and reliability of vehicle movement information, as well as increased safety and security for both drivers and passengers. The result for this research is sub-divided into three categories, and this is discussed as follow:

Table 1: Data Logs for Vehicle at Entrance and Exit at Federal University of Technology Minna

S/N	Car Theft	Time In	Time Out	Date	Vehicle
0	12	8:45am	11:00am	08/02/2023	*MNA 350 MC*
1	10	11:00am	02:00pm	10/02/2023	*MNA 389 ZR*
2	8	07:30am	03:58pm	01/02/2023	*MNA 340 SR*
3	6	08:00am	08:25am	11/02/2023	*MNA 350 FX*
4	8	10:30am	01:30pm	21/02/2023	*MNA 334 AC*
5	5	07:00am	03:00pm	28/02/2023	*MNA 435 FC*

Table 1 shows the data logs of crime that was done by 6 vehicles that were used for demonstration in Federal University of Technology Minna. The data in the table shows information for six different vehicles (with license plate numbers MNA 350 MC, MNA 389 ZR, MNA 340 SR, MNA 350 FX, MNA 334 AC, and MNA 435 FC) and their corresponding entry and exit times, dates, and incidents of car theft. For example, vehicle MNA 350 MC was

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associated with 12 incidents of car theft and entered the campus at 8:45am and exited at 11:00am on 08/02/2023. The data in the table was collected as part of a system model used to detect violations related to car theft. The model was tested using different license plate numbers and scenarios, and the outcomes were recorded in the table. The tests were conducted at the main entrance of the Federal University of Technology Minna, and the results were used as part of a Car theft Test. Table 1 provides a summary of the data logged during these tests, including the number of car thefts associated with each license plate number, entry and exit times, and dates. The figure 4 shows the vehicle and motor cycle plate number at the entrance and exit at Federal University of Technology Minna.

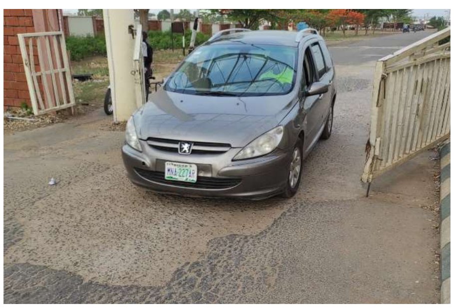

Figure 4: Vehicle plate number at the entrance and exit at Federal University of Technology Minna

H. Result and discussion of centralized database architecture for vehicle monitoring and control in Federal Univeristy of Technology Minna.

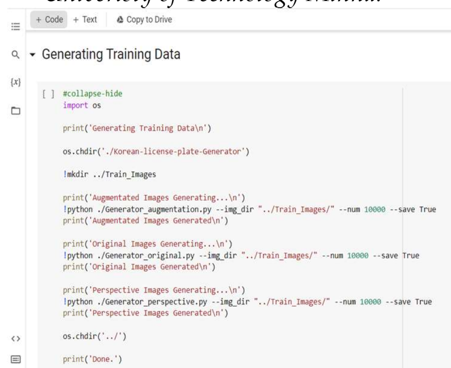

Figure 5: Centralized Database Server Control System

The model was trained using data collected and stored in a centralized Google Colab database, as shown in Figure 4.4. With Google Colab, a free cloud-based platform, you can create a data recording model for a metropolitan vehicle movement monitoring and control system. It supports numerous programming languages, including Python, and provides a notebook-style environment similar to Jupyter. Some potential applications of Google Colab in creating the data logging model are as follows:

It is essential for the proper functioning of the data logging model, and Google Colab provides the tools for cleaning and preparing data. Colab's data analysis features make it possible to look for trends and patterns in your data, information that is essential for fine-tuning your data logging methodology. The platform allows for the creation of machine learning models, which may be used to construct the data logging model for the metropolitan vehicle movement monitoring and control system. With Colab, you can put your data logging model through its paces and see how well it performs, which will help you pinpoint

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any weaknesses in your setup. Colab facilitates communication and coordination between developers working in parallel on the data logging model, leading to faster iterations and better solutions. In conclusion, Google Colab was an effective platform for data analysis, model building, testing, and cooperation in the creation of a data logging model for a metropolitan vehicle movement monitoring and control system.

I. Result and discussion of data logging and storage scheme with graphical user interface for the Institution.

Figure 6 depicts the vehicle authentication and registration phase of a metropolitan vehicle movement monitoring and control system. This is the sole place in the logs where the administrator can access the Metropolitan Vehicle Movement Monitoring and Control System. Figure 7 also depicts the data-logging vehicle monitoring system's logs part.

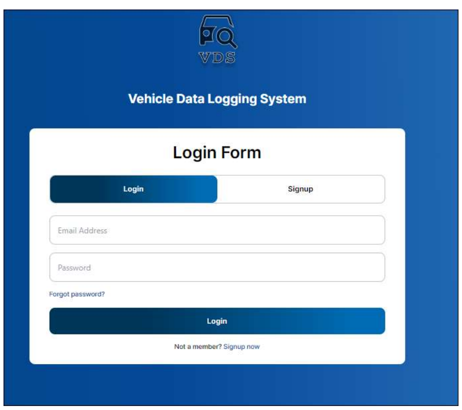

Figure 6: Authentication and signup section for the Data Logging Vehicle Monitoring System

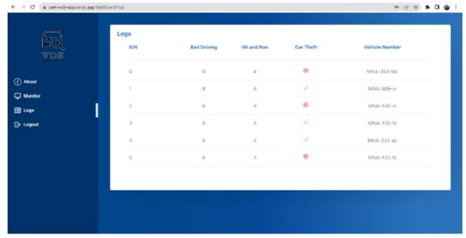

Figure 7: Logs Section for the Data Logging Vehicle Monitoring System

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REFERENCES

[1] Coates, A., Huval, B., Wang, T., Wu, D. J., & Ng, A. Y. (2012). Deep learning with COTS HPC systems. Proceedings of the 30th International Conference on Machine Learning, Atlanta, Georgia, USA, 2013. 1–9.

[2] Wukkadada, B., & Fernandes, A. (2020). Automatic Number Plate Recognition System : Machine Learning Approach. IOSR Journal of Computer Engineering. 34–39.

[3] Cunha, B., Madureira, A., Fonseca, B., & Matos, J. (2021). Intelligent Scheduling with Reinforcement Learning. Applied Sciences Intelligent Scheduling with Reinforcement Learning. 11(3170), 1–22. https://doi.org/10.3390/app11083710.

[4] Fernando, L., L, D. M., Garc, F. S., Hern, N., & Nuria, G. (2021). Speed Proportional Integrative Derivative Controller : Optimization Functions in Metaheuristic Algorithms.

Corresponding author: Taye Hassan Salami
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Department of Mechatronics Engineering, Federal University of Technology, Minna, Niger State.

Journal of Advanced Transportation,(2021), 1-12.

[5] Ghosh, A. (2020). Vehicle Tracking System using IoT. Master of Computer Applications (A Central University) PUDUCHERRY-605014. May 2018. https://doi.org/10.13140/RG.2.2.12437.96482

[6] Patel, F., Solanki, J., Rajguru, V., & Saxena, A. (2018). Recognition of Vehicle Number Plate Using Image Processing Tech- nique. Medicaps Institute of Technology and Management Indore, MP, India. 2(2), 1–7. https://doi.org/10.18686/wct.v2i2.418

[7] Gunawan, A. A. S., Aprilia, D. A., & Gunawan, F. E. (2019). Detection of Vehicle Position and Speed using Camera Calibration and Image Projection Methods. 4th International Conference on Computer Science and Computational Intelligence 2019 (ICCSCI) 12-13 September 2019, Procedia Computer Science, 157, 255–265. https://doi.org/10.1016/j.procs.2019.08.165

[8] Gura, D., Markovskii, I., Khusht, N., Rak, I., Pshidatok, S. (2021). A Complex for Monitoring Transport Infrastructure Facilities Based on Video Surveillance Cameras and Laser Scanners. TransSiberia 2020 Conference. Transportation Research Procedia, 54(2020), 775–782. https://doi.org/10.1016/j.trpro.2021.02.130

[9] Hordri, N. F., Yuhaniz, S. S., & Shamsuddin, S. M. (2016). Deep Learning and Its Applications : A Review. Advanced Informatics School, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia. (2017), 1-5.

[10] Kranthi, S., Pranathi, K., & Srisaila, A. (2011). Automatic Number Plate Recognition. International Journal of Advancements in Technology, 2(3), 408–422.

[11] Rajadurai, M., Yuvaraaj, K. V., Veera. P. S., & Jajini, M. (2020). IoT Based Accident Monitoring And Controlling System With Data Logging Facility. International Research Journal of Engineering and Technology (IRJET). 7(4), 2610–2614.

[12] Bagade, J. V, Kamble, M., Pardeshi, K., Punjabi, B., & Singh, R. (2018). Vehicle Tracking System using GSM and GPS Technologies. IOSR Journal of Computer Engineering. 05–08.

[13] Thet, W. M., Maung, M., & Tun, H. M. (2015). Real-Time Vehicle Data Logging System Using GPS And GSM. International Journal of Scientific and Technology Research, 4(07), 44–49.

[14] Indolia, S., Goswamib, K. A., Mishra, S. P., & Asopa, P. (2018). Conceptual Understanding of Convolutional Neural Network- A Deep Learning Approach. International Conference on Computational Intelligence and Data Science (ICCIDS 2018), 132, 679–688. https://doi.org/10.1016/j.procs.2018.05.069.

[15] Li, Y., Carabelli, S., Fadda, E., Manerba, D., Tadei, R., & Terzo, O. (2020). Machine learning and optimization for production rescheduling in Industry 4 . 0. The International Journal of Advanced Manufacturing

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Technology (2020) 110:2445–2463.

[16] Kaluarachchi, T., Reis, A., & Nanayakkarasensors, S. (2021). A Review of Recent Deep Learning Approaches in Human-Centered Machine Learning. Sensors, 21(2514), 1-29.

[17] Shehata, M., Abo-alez, R., Zaghlool, F., & Abou-kreisha, M. T. (2020). Deep Learning Based Vehicle Tracking in Traffic Management. International Journal of Computer Trends and Technology (IJCTT), 67(3), 5-8. https://doi.org/10.14445/22312803/IJCTT-V67I3P102

[18] Guido, G., Gallelli, V., Rogano, D., & Vitale, A. (2017) Evaluating the accuracy of vehicle tracking data obtained from Unmanned Aerial Vehicles. International Journal of Transportation Science and Technology, 5(3), 136–151. https://doi.org/10.1016/j.ijtst.2016.12.001

[19] Najafabadi, M. M., Villanustre, F., Khoshgoftaar, T. M., Seliya, N., Wald, R., & Muharemagic, E. (2015). Deep learning applications and challenges in big data analytics. Journal of Big Data, 1–21. https://doi.org/10.1186/s40537-014-0007-7

[20] Schmidhuber, J. (2015). Deep learning in neural networks : An overview. Neural Networks, 61, 85–117. https://doi.org/10.1016/j.neunet.2014.09.003

[21] Mohana & Aradhya, R. H. V. (2019). Object Detection and Tracking using Deep Learning and Artificial Intelligence for Video Surveillance Applications. International Journal of Advanced Computer Science and Applications, 10(12), 517-530.

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