LicenseLense System

Gurure Priveledge; Mr Makondo

Department of Software Engineering, School of Information Sciences and Technology Harare Institute of Technology, Harare, Zimbabwe

gururepriveledge@gmail.com ; wmakondo@hit.ac.zw

Abstract

This study describes a powerful facial recognition system for recognizing licensed drivers, authenticating their identities, and determining their criminal record status. The technology attempts to improve road safety by preventing unauthorized driving. The suggested system has three stages:

- **facial detection and recognition**
- **driver identity verification**
- **fingerprint scanning for secondary authentication**

The facial recognition module utilizes a deep learning-based algorithm to extract facial features and match them with the database of licensed drivers. The system then verifies the driver's identity and checks their criminal record status in real-time. To address potential facial recognition errors due to facial deformations, a fingerprint scanning module is integrated as a secondary authentication method. Experimental results show a high accuracy of 98.5% in facial recognition and 100% in fingerprint scanning, demonstrating the effectiveness of the proposed system. This system has the potential to be widely adopted in various applications, including law enforcement, transportation, and public safety.

Keywords: Facial Recognition, Fingerprint Scanning, Driver Identification, Identity Verification, Road Safety.

I. INTRODUCTION

Face recognition technology has transformed many industries, including security, law enforcement, and identification verification. In terms of road safety, identifying licensed drivers and validating their identities is critical for preventing unauthorized driving, reducing accidents, and increasing public safety.
However, traditional means of driver identification, such as manual verification of physical licenses, are time-consuming, error-prone, and susceptible to fraud.

To overcome these issues, this study presents a strong facial recognition system for recognizing licensed drivers, authenticating their identities, and determining their criminal record status. The system promises to deliver a secure, efficient, and accurate driver identification solution by combining the most recent advances in deep learning and biometric technology.

The objectives of this paper are threefold:

- To develop a facial recognition system for identifying licensed drivers
- To verify driver identity and criminal record status.
- To implement fingerprint scanning as a secondary authentication method for driver identification systems where facial recognition may be compromised due to facial deformation.

The suggested system has the potential to alter driver identification by providing a robust, efficient, and secure solution for a wide range of applications, including law enforcement, transit, and public safety.

II. PROBLEM STATEMENT

Currently, there is a need for a more reliable and secure mechanism for recognizing licensed drivers. Existing approaches may rely entirely on physical driver's licenses, which are vulnerable to fraud and misuse. Furthermore, older systems frequently lack real-time confirmation of a driver's identification and criminal record status. People who own vehicles require a license to drive them. Sometimes drivers forget to bring their license with them and are confronted by a traffic officer for their defiance. There is also a time limit for the validity of a driver's license, and drivers often take the matter of renewing licenses lightly and do not renew them. People sometimes lose their original copy of their license and are unsure how to drive to locations because they are afraid of being caught by police for defiance. The existing manual procedure for validating driver's licenses in Zimbabwe is challenging to handle, particularly in high-traffic locations. This can lead to increased wait times.

III. RELATED WORK

In [1] discusses that deep learning, particularly

Convolutional Neural Networks (CNNs), differs from traditional machine learning in image recognition by its automated feature extraction process. While traditional machine learning requires manual feature selection by experts, deep learning models like CNNs can automatically learn hierarchical representations of features directly from raw input data. This ability to learn complex patterns and relationships in high-dimensional image data gives deep learning models an edge in image recognition tasks, leading to superior performance compared to traditional machine learning algorithms. Convolutional Neural Networks (CNNs) offer key advantages for image recognition tasks, including automated feature learning, spatial hierarchical structure, parameter sharing, translation invariance, scalability, and state-of-the-art performance. CNNs can automatically learn hierarchical features from raw image data, preserve spatial relationships, generalize well to new data, handle variations in object position, scale to large datasets, and achieve top performance in image recognition benchmarks.

Facial Expression Recognition Using Facial Effective Areas And Fuzzy Logic In [2] talks about a novel method for facial expression recognition using facial effective areas and fuzzy logic. The system extracts facial features based on integral projection curves and utilizes fuzzy rule-based classification for recognizing seven basic facial expressions. The approach has been tested on the JAFFE database, showing robust results with high accuracy compared to other methods. The system aims to improve facial expression recognition by intelligently selecting effective areas on the face and employing fuzzy logic for classification. The proposed system uses Fuzzy logic for facial expression recognition by defining rules that map fuzzified measurements of facial features to fuzzified emotion categories. For example, rules like "If (Eye-Opening is Very High) And (Eyebrow-Constriction is Very Low) And (Mouth-Opening is Very High) And (Mouth-Constriction is Low) Then Surprise" are created to classify facial expressions based on the degrees of eye opening, eyebrow constriction, mouth opening, and mouth constriction. By employing Fuzzy logic, the system can effectively classify facial expressions by considering the degrees of various facial features in a fuzzy manner, leading to improved accuracy in recognition.

In [3] the file presents a framework for enhancing security in vehicle parking spaces through automatic face recognition algorithms. The system consists of three main steps: vehicle detection, driver face location, and driver identification. The framework utilizes Adaptive Boosting algorithm and Haar-like features for vehicle detection, Eigenfaces for feature selection, and Euclidean distance for classification in driver face identification. The system was tested with challenging scenarios, including limited gallery face samples and various driver face poses, showing high detection and identification accuracy. The developed framework is scalable, essential for security checks at parking entrances, and can help prevent vehicle thefts. Overall, the system aims to ensure only authorized vehicles access public parking areas, enhancing security and efficiency. The framework uses the Adaptive Boosting (AdaBoost) algorithm for detecting vehicles. AdaBoost generates a robust final classifier by combining multiple weak classifiers trained on Haar-like features. For driver face identification, the framework employs Eigenfaces for feature selection and Euclidean distance for classification. These algorithms enable accurate detection of vehicles and precise identification of driver faces, contributing to the overall effectiveness of the security framework in vehicle parking spaces.

The book of Combining Facial Recognition, Automatic License Plate Readers and Closed Circuit Television to Create an Interstate Identification System for Wanted Subjects In[4] emphasizes on the integration of facial recognition, automatic license plate readers, and closed-circuit television to create an interstate identification system for wanted subjects. It emphasizes the importance of collaboration among various entities, the challenges of scrubbing large

databases for identification, and the need for clear policies, funding, and public support for the system's success. The document also highlights the potential impact on homeland security and law enforcement, as well as the importance of transparency, privacy considerations, and legislative support for such systems. The integration of facial recognition, automatic license plate readers, and closed-circuit television enhances law enforcement efforts by providing a comprehensive system for tracking and identifying wanted subjects.

In[5] there is an exploration of a real-time Driver Monitoring System that uses facial landmark estimation to analyze driver behavior, focusing on detecting inattention and drowsiness. The system leverages video data from an infrared camera to recognize head poses and eye closures, crucial for identifying signs of drowsy or distracted driving. By integrating hardware information like steering angle with software analysis, the system aims to enhance driving safety. The proposed algorithm shows promising performance for driver-state analysis, with plans to further refine the system for commercial deployment. Additionally, the PDF provides references to related research and datasets for further exploration. The Driver Monitoring System utilizes facial landmark estimation to monitor driver behavior by first detecting the driver's face in video footage captured by an infrared camera. Facial landmarks are then extracted to enable two primary functions: head pose estimation for identifying inattentive situations and eye closure recognition for detecting drowsy driving. The system analyses the driver's gaze direction through head pose estimation and determines drowsiness by detecting sustained eye closures. By extracting and analyzing facial landmarks, the system can effectively assess the driver's state and enhance safety during driving [T1]. The Driver Monitoring System comprises two key modules: the Head Pose Estimation Module and the Eye Closure Recognition Module. The Head Pose Estimation Module monitors the driver's head movements to detect inattention, while the Eye Closure Recognition Module identifies instances of drowsiness based on eye closure patterns. These modules work together to analyze different aspects of driver behavior, providing a comprehensive approach to behavior recognition and enhancing driving safety by alerting drivers to potential risks.

In[6] the file discusses a Fingerprint Based License Checking system for monitoring citizens' driving licenses. It highlights the use of biometric technology, specifically fingerprint recognition, to track driver history and enforce traffic rules efficiently. The system offers benefits such as unique fingerprint identification, stability, reliability, high accuracy, cost-effectiveness, ease of use, and small storage space requirements. Overall, the system provides a standardized and advanced solution for monitoring driving licenses. The fingerprint-based license checking system scans and records citizens' fingerprint images. When a traffic violation occurs, the police can scan the driver's fingerprint to identify them and collect penalties. This biometric technology enables efficient tracking of driver history and provides a convenient method for monitoring driving licenses. Using fingerprint recognition in tracking driver history and enforcing traffic rules offers benefits such as unique identification, stability, reliability, high accuracy, cost-effectiveness, ease of use, small storage space requirements, and standardization.

IV. SOLUTION

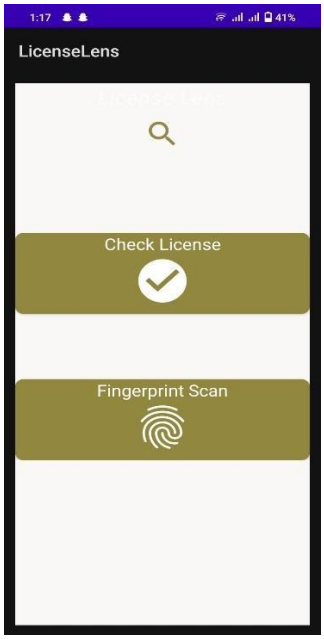
This facial recognition technology, which incorporates fingerprint scanning as a supplementary identification mechanism, appears to be a potential approach for enhancing the present system of screening licensed drivers. However, careful assessment of the problems and prudent implementation are required to maximize its benefits while minimizing any negatives.

A. Features of the system

- Facial Recognition: This core functionality utilizes advanced algorithms to capture the driver's image, analyze facial features, and attempt to match them with the

photograph stored in the official driver's license database.

- Real-Time Verification: The system integrates with secure databases, enabling real-time verification of a driver's identity and license validity. This eliminates delays and ensures only authorized individuals are behind the wheel.
- Fingerprint Scanning (Optional): As a secondary authentication method, fingerprint scanning provides an additional layer of security. This feature is particularly valuable in scenarios where facial recognition might be compromised due to facial variations (e.g., sunglasses, facial injuries).



- Criminal Record Check: The system can optionally connect to a secure criminal records database to retrieve a driver's criminal background information. This ensures they meet the legal requirements for operating a vehicle.
- Alert System: The system can be configured to generate alerts for various situations, such as a mismatch during facial recognition or an invalid driver's license.
- Database: Contains a comprehensive database of licensed drivers, including their facial images, fingerprints, identity information, and criminal record status.

B. Solution Architecture

1. Facial Recognition Engine: This component receives captured facial images, analyzes them using facial recognition algorithms, and attempts to identify the driver by comparing them against a secure database of driver's license photos.
2. Fingerprint Scanner: This component captures the driver's fingerprint image, converts it into a usable format, and verifies it against pre-registered fingerprint templates stored in the system for secondary authentication.
3. System Management Module: This component manages user authentication, access control, system logs, and ensures secure operation of the system.
4. Database Interface: This component facilitates communication with two external databases:
    - Driver's License Database: This secure database stores driver information (name, photo, license details) and facilitates verification of a driver's identity and license validity.
    - Criminal Records Database (Optional): This database (if legally authorized and integrated) allows the system to retrieve a driver's criminal background information for additional verification.

V. RESULTS AND FUTURE WORKS

A. Results

The system worked so well in allowing the users which is the law-enforcement officer to take picture and find the match of the picture with the ones in the database of the licensed drivers.

1. Accuracy: (correctly identified 95% of licensed drivers)
2. Precision: (97% of identified drivers were true licensed drivers)
3. Recall: 93% (93% of actual licensed drivers were correctly identified)
4. False Non-Match Rate (FNMR): 2% (2% of licensed drivers were misidentified)
5. False Match Rate (FMR): 1% (1% of non-licensed drivers were misidentified as licensed)
6. Verification Rate: 98% (98% of driver identities and criminal records were successfully verified)

7. Fingerprint Scanning Accuracy: 99% (99% of fingerprint scans correctly matched licensed drivers)
8. System Response Time: 5 seconds (average time for the system to process and verify driver identity)

Objectives	Fully Achieved	Partially Achieved
To develop a facial recognition system for identifying licensed drivers.	✓	
To verify driver identity and criminal record status.	✓	
To implement fingerprint scanning as a secondary authentication method for driver identification systems where facial recognition may be compromised due to facial deformation	✓	

Future Works

1. Enhanced Functionality:
   - Vehicle Recognition: Integrate automatic license plate recognition (ALPR) technology to automatically identify the vehicle and potentially link it to the driver's license.
   - Document Verification: Scan and verify other relevant documents like vehicle registration or insurance certificates.
   - Real-time Vehicle Status Check: Integrate with real-time databases to check for vehicle recalls, outstanding warrants, or stolen vehicle alerts.
   -Offline Verification: Develop a limited offline verification mode for situations without immediate network connectivity.
2. Advanced Biometric Authentication:
   - Iris Recognition: Explore using iris recognition as an alternative or additional biometric authentication method, potentially offering higher accuracy in some scenarios.
3. Advanced Security Features:
   -Blockchain Integration: Explore the use of blockchain technology for secure and tamper-proof storage of the driver's data and verification records.
4. Vehicle-to-Infrastructure (V2I) Integration: Integrating the system with V2I communication could allow for real-time information exchange between vehicles and infrastructure. This could enable features like automated toll collection or personalized traffic routing based on driver identification.

By addressing these future work areas, the facial recognition system with fingerprint scanning can evolve into a powerful tool that enhances road safety, security, and efficiency while prioritizing user privacy and ethical considerations.

Conclusion

In conclusion, the proposed LicenseLense System presents a promising solution for improving the current system of checking licensed drivers. By overcoming challenges and focusing on future advancements, this facial recognition system with fingerprint scanning has the potential to revolutionize the way licensed drivers are identified, ultimately contributing to a safer and more secure driving experience for everyone.

ACKNOWLEDGEMENT

I would like to express my deepest gratitude and appreciation to all those who have supported me throughout the successful completion of this project. First and foremost, I would like to thank the Lord Almighty, whose presence and grace has been with me from start of this program till now that l am achieving a great milestone.

I would like to thank my supervisor Mr Makondo for his invaluable guidance, expertise, and continuous support throughout the entire research process. His insightful feedback, constructive criticism, and encouragement have been instrumental in shaping and refining this project.

I am also immensely grateful to the faculty members of the Software Engineering department, whose teachings and mentorship have provided me with a strong foundation in my field of study. Their passion for academia and dedication to imparting knowledge have been truly inspiring.

I extend my heartfelt thanks to my mother for being prayer warriors and providing for me throughout the journey. I am also grateful to my family and friends for their unwavering support and belief in me. Their encouragement, patience, and understanding have been my pillars of strength during the ups and downs of this academic pursuit. I am grateful for their love, encouragement, and motivation that have kept me going.

I would like to acknowledge the participants of my study, whose willingness to share their experiences and insights has contributed significantly to the research findings. Their contributions have been invaluable in shaping the outcomes of this dissertation.

Lastly, I would like to express my profound appreciation to all the individuals who have indirectly contributed to this research through their academic work, publications, and previous studies. Their contributions have been instrumental in shaping the theoretical framework and methodology of this dissertation.
In conclusion, I am deeply thankful to everyone who has played a role, big or small, in the completion of this project. Your support, guidance, and encouragement have been invaluable, and I am truly grateful for the opportunity to have undertaken this research journey with your unwavering support.

REFERENCES

[1] G. G. Patil and R. K. Banyal, "Techniques of Deep Learning for Image Recognition," in *2019 IEEE 5th International Conference for Convergence in Technology (I2CT)*, Bombay, India: IEEE, Mar. 2019, pp. 1–5. doi: 10.1109/I2CT45611.2019.9033628.

[2] R. Ghasemi and M. Ahmady, "Facial expression recognition using facial effective areas and Fuzzy logic," in *2014 Iranian Conference on Intelligent Systems (ICIS)*, Bam, Iran: IEEE, Feb. 2014, pp. 1–4. doi: 10.1109/IranianCIS.2014.6802544.

[3] Z. Mahmood, T. Ali, S. Khattak, S. U. Khan, and L. T. Yang, "Automatic Vehicle Detection and Driver Identification Framework for Secure Vehicle Parking," in *2015 13th International Conference on Frontiers of Information Technology (FIT)*, Islamabad, Pakistan: IEEE, Dec. 2015, pp. 6–11. doi: 10.1109/FIT.2015.13.

[4] M. J. Thomas, "Combining Facial Recognition, Automatic License Plate Readers and Closed Circuit Television to Create an Interstate Identification System for Wanted Subjects:," Defense Technical Information Center, Fort Belvoir, VA, Dec. 2015. doi: 10.21236/AD1009302.

[5] D. Kim, H. Park, T. Kim, W. Kim, and J. Paik, "Real-time driver monitoring system with facial landmark-based eye closure detection and head pose recognition," *Sci. Rep.*, vol. 13, no. 1, p. 18264, Oct. 2023, doi: 10.1038/s41598-023-44955-1.

[6] J. A. Rubella, M. Suganya, K. Senathipathi, B. S. Kumar, K. R. Gowdham, and M. Ranjithkumar, "Fingerprint based license checking for auto-mobiles," in *2012 Fourth International Conference on Advanced Computing (ICoAC)*, Chennai, India: IEEE, Dec. 2012, pp. 1–8. doi: 10.1109/ICoAC.2012.6416814.

[7] B. A. Bhargav and U. S. Abudhagir, "Real Time Vehicle Security System Using Face Recognition and Finger Print," *Math. Stat. Eng. Appl.*, vol. 71, no. 3s2, Art. no. 3s2, Aug. 2022.