**License Plate Detection and Face Recognition for Driver Identification in Vehicle Monitoring Systems**

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**Abstract**

This study presents an innovative approach to vehicle identification and driver profiling by integrating template matching for license plate detection with Convolutional Neural Network (CNN)-based face recognition. Traditional template matching techniques are employed to detect and recognize vehicle registration numbers. However, in cases where the license plate is obscured, missing, or unreadable, CNN-based face recognition is utilized for driver identification. The proposed hybrid approach enhances the robustness and accuracy of vehicle monitoring systems by ensuring a reliable two-way authentication process.

**Methodology**

The proposed methodology combines template matching for license plate detection with deep learning-based face recognition to ensure reliable vehicle and driver identification. The key steps in the methodology are as follows:

1. **Data Collection**: A dataset consisting of images of vehicles under varying environmental conditions is gathered. The dataset is annotated with ground-truth labels for license plate regions and corresponding driver faces.
2. **Preprocessing**: All images are standardized to a uniform size. Image enhancement techniques, such as histogram equalization, are applied to improve contrast and clarity.
3. **License Plate Detection using Template Matching**: A sliding window approach extracts the Region of Interest (ROI) for license plates. Template matching techniques are applied to identify license plate regions, followed by post-processing methods like non-maximum suppression to refine detection accuracy.
4. **Face Detection using CNN**: A pre-trained CNN model (e.g., Haar Cascade, MTCNN) is used to detect faces within the vehicle region. Bounding box regression and non-maximum suppression are applied to improve localization precision.
5. **Face Recognition using CNN**: A fine-tuned CNN model (e.g., VGG, ResNet) is trained on the dataset for face recognition. Extracted facial features are compared with stored templates in a database to identify the driver.
6. **Driver Identification and Vehicle Monitoring**: The detected driver is associated with the corresponding vehicle using spatial and temporal proximity analysis. Identified driver information and vehicle metadata are stored for monitoring purposes, with alerts generated for unauthorized drivers or suspicious activities.

The integration of template matching and CNN-based face recognition significantly enhances vehicle monitoring systems by providing an accurate and reliable two-way authentication mechanism.

Reference : Mustafa, T., & Karabatak, M. (2024). Real time car model and plate detection system by using deep learning architectures. *IEEE Access*.