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Cognitive Driver Action Recognition

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Abstract: Operating an automobile is a multifaceted endeavor, demanding unwavering focus and attention from the driver. Distracted driving, encompassing any behavior that diverts the driver's concentration away from the road, poses a grave threat to road safety. Alarming statistics reveal that approximately 1.35 million lives are tragically lost each year due to road traffic accidents, inflicting significant economic ramifications, with road traffic crashes costing most nations an estimated 3% of their gross domestic product.

In light of this sobering reality, the primary objective of our project is to implement a comprehensive system for the discernment of safe driving practices and the identification of potentially hazardous actions by drivers. Leveraging a diverse array of Machine Learning Models, we endeavor to accurately categorize the provided images into distinct classes corresponding to different forms of driver distraction. Additionally, our research extends beyond mere classification, aiming to conduct a comparative evaluation of various Machine Learning Models to ascertain their performance and accuracy within the context of cognitive driver action recognition. This holistic approach underscores our commitment to enhancing road safety and minimizing the risk of accidents and harm to fellow road users.

Index Terms – CNN, Action Recognition, Image Classification.

I. INTRODUCTION

This project is dedicated to the task of detecting and classifying driver activities based on images, employing a variety of sophisticated deep-learning techniques. At its core, the primary objective of this endeavor is to develop an exceptionally accurate model capable of categorizing driver actions into distinct predefined categories. The overarching goal is to harness the classification capability to ascertain whether a driver is actively engaged in safe driving practices or is, regrettably, not adhering to recommended safety protocols.

In the contemporary landscape of road safety, many states have enacted stringent regulations against behaviors such as texting, talking on a cell phone, and other distracting activities while driving. Recognizing the pressing need for enhanced safety measures, we firmly believe that through the strategic application of Machine Learning algorithms, we can effectively discern the risk of potential accidents by classifying driver images into specific distracted classes. The meticulous collection of data for further in-depth analysis constitutes an integral aspect of this initiative.

The ability to instantaneously detect and flag instances of distracted driving in real-time within a smart vehicle environment holds substantial promise for the mitigation of road accidents. By harnessing advanced machine learning and computer vision techniques, we aim to accurately identify and interpret a spectrum of actions and behaviors exhibited by drivers. In doing so, our ultimate aspiration is to proactively reduce the incidence of accidents through the timely recognition of cognitive driver actions that deviate from safe driving practices. With the effective and real-time implementation of this technology, a significant reduction in accidents is indeed achievable, aligning with the imperative of road safety in today's dynamic and evolving transportation landscape.

II. RESEARCH METHODOLOGY

Following diagram shows the work flow or data flow of the user input and at each stage and how the data is processed.

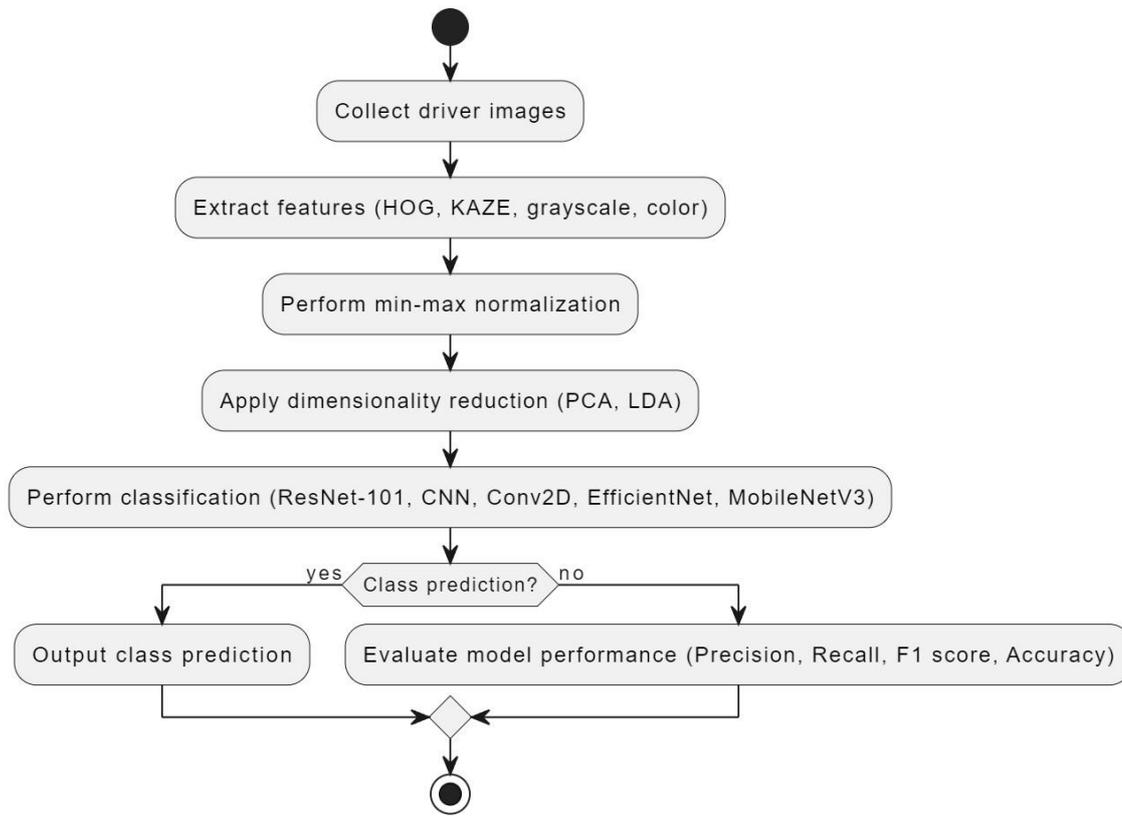
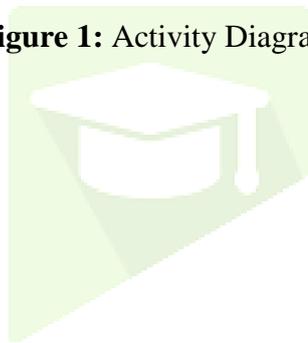
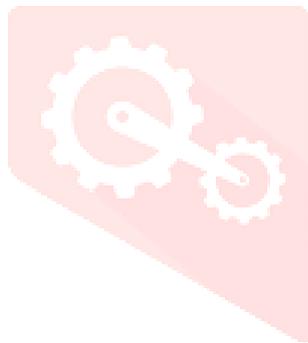


Figure 1: Activity Diagram.



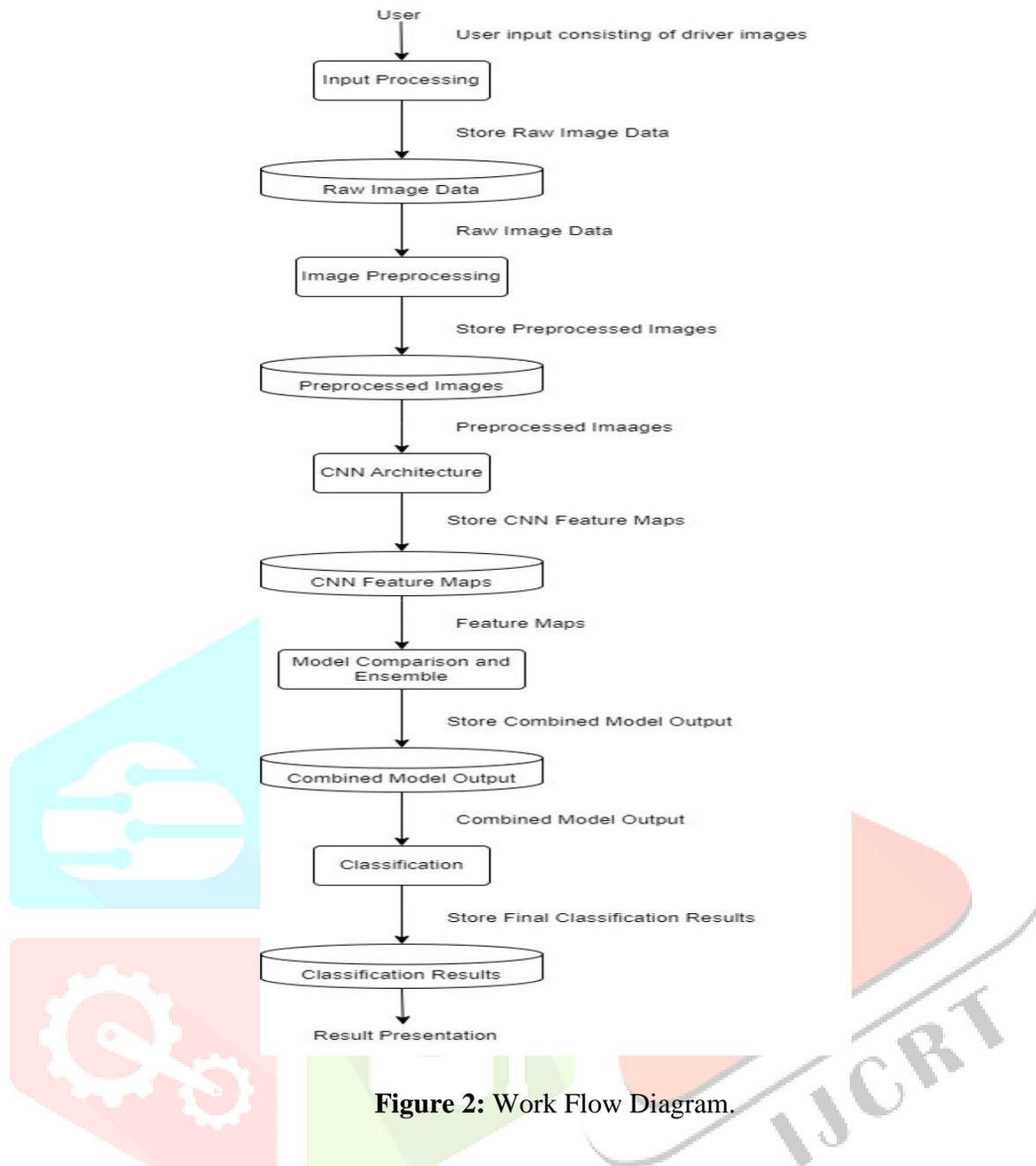


Figure 2: Work Flow Diagram.

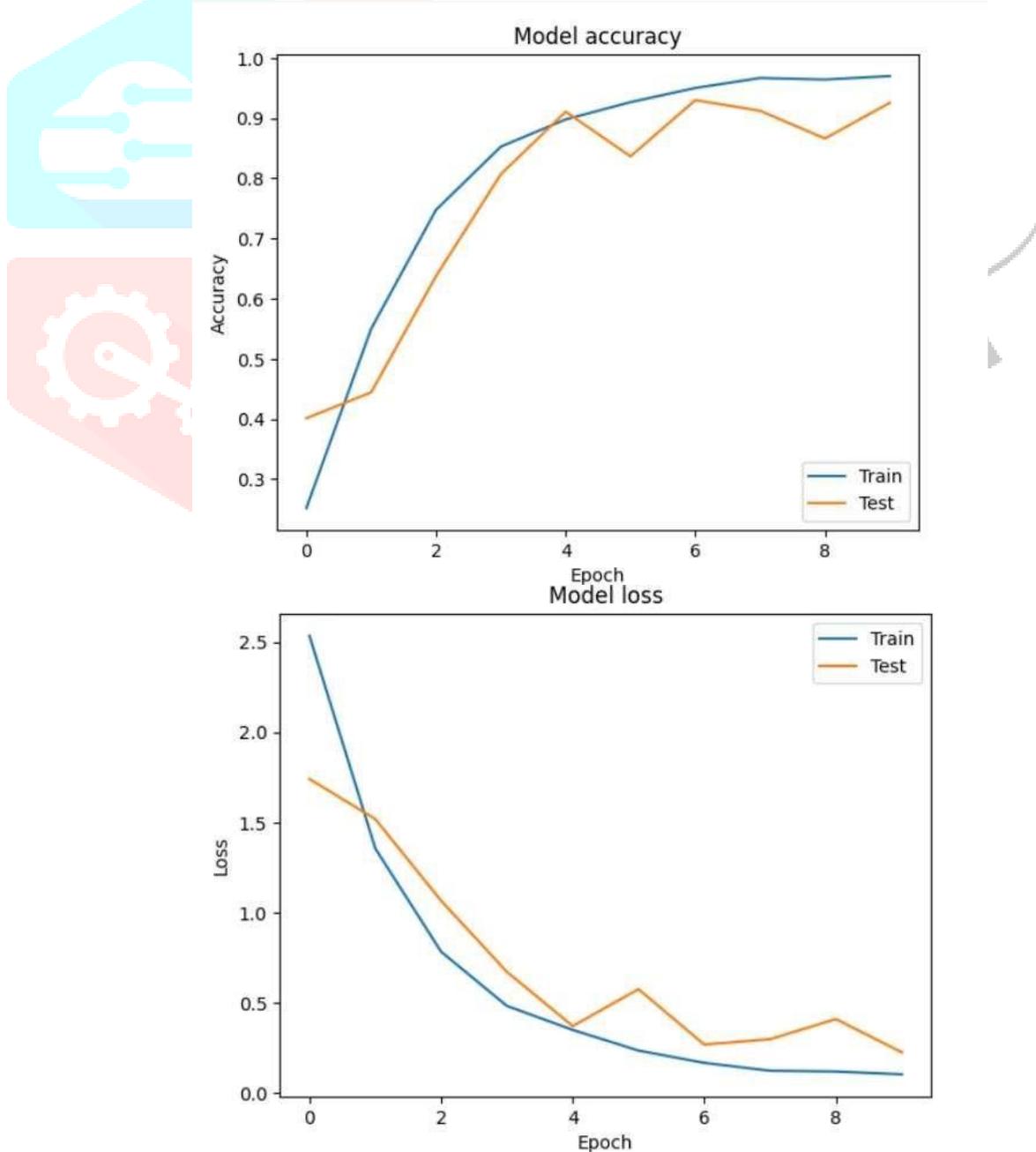
In methodology following algorithms are used:

1. Conv2D: Conv2D is a type of mathematical operation used in deep learning to extract features from two-dimensional data, such as images.
2. EfficientNetB0: EfficientNetB0 is a family of convolutional neural network models that achieve high accuracy with fewer parameters, making them efficient for various computer vision tasks.
3. MobileNetV3: MobileNetV3 is a lightweight and efficient convolutional neural network designed for mobile and embedded devices, providing fast and accurate image classification.
4. Densenet121: Densenet121 is a deep convolutional neural network architecture that emphasizes feature reuse and connection densification for improved model performance.
5. Ensemble : Ensemble methods are techniques that create multiple models and then combine them to produce improved results

III. RESULTS AND DISCUSSION

The baseline Convolutional Neural Network (CNN) model achieved a classification accuracy of 93% on the test dataset. While providing a foundational framework, the baseline model demonstrated limitations in accurately distinguishing between certain driver actions, particularly those with subtle visual cues. Transfer Learning Model Performance: DenseNet, Efficient Net, and MobileNet were individually fine-tuned for the driver action recognition task. DenseNet: Achieved an accuracy of 89%, showcasing strong performance in capturing complex spatial features relevant to driver actions. EfficientNet: Attained an accuracy of 96%, demonstrating efficient utilization of model parameters and computational resources while maintaining competitive accuracy. MobileNet: Delivered an accuracy of 94%, showing suitability for resource-constrained environments without significant compromise on classification performance. Ensemble Model Performance. An ensemble model was constructed by combining predictions from DenseNet, EfficientNet, and MobileNet using a weighted averaging technique. The ensemble model achieved a notable improvement in accuracy, surpassing the performance of individual models with an overall accuracy of 97%. The ensemble approach effectively leveraged the complementary strengths of each model variant, resulting in enhanced robustness and generalization capabilities. Web-Based Application Deployment The web- based application for Smart Cognitive Driver Action Recognition was successfully deployed on a reliable hosting platform. Users can upload images of drivers engaging in various activities through the intuitive interface and receive real-time classification results. The API backend ensures efficient handling of image processing requests, enabling seamless integration into diverse environments such as in-car systems or smartphone applications.

Accuracy Chart:



The ratio of the number of correct predictions to the total no of predictions made is known as accuracy. The accuracy of the model comes out to be 0.993. Dividing the count of true positives by the total count of positive predictions made by the model gives us the precision of a class. The precision of the model comes out to be 0.99. It is the proportion of relevant items that were correctly identified by a classification model. The recall of the model comes out to be 0.991. It is the harmonic mean of precision and recall, providing a single metric that balances both measures in binary classification tasks. The F1 score of the model comes out to be 0.99.

IV. Acknowledgment

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