PROJECT WORK - PRESENTATION ON

SELF-DRIVING CARS ON INDIAN ROADS USING MACHINE LEARNING

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OUTLINES OF THE PRESENTATION

ACRONYMS

CNN	-	Convolutional Neural Networks
RNN	-	Recurrent Neural Networks
MNIST database	-	Modified National Institute of Standards and Technology database
ReLU	-	Rectified Linear Unit
NLP	-	Natural language processing
CV	-	Computer vision

ABSTRACT

Nowadays automation is playing a vital role in the development of infrastructure. Automation in the automobile industry is advancing in the direction of driverless cars. The aim of this project is to develop a self-driving car using deep learning algorithms.The project uses computer vision, machine learning and convolutional neural networks to recognize the image and processing. The project starts with basic image processing techniques such as grayscale conversion, smoothening images and edge detection. Further, it uses the Hough transform algorithm for detection of lane lines in the road.The project implements the LeNet architecture for classifying road symbols and also uses the Nvidia model for behavioral cloning. The project also uses data collection and preprocessing techniques, such as data balancing and image augmentation. Finally, the project uses Flask and Socket.io for live testing of the self-driving car.

It starts with the basics of supervised learning, classification, linear models, and error functions. Then it covers the use of neural networks, including feedforward, backpropagation and non-linear boundaries.The project uses the Udacity simulation software to train a neural network to drive a car in a simulated environment.

OBJECTIVES

- Develop a safe and reliable autonomous driving system that can accurately navigate a vehicle on roads, without the need for human intervention.
- Use advanced machine learning algorithms to process and analyze visual data from cameras mounted on the car, and use this information to make informed decisions about steering, acceleration, and braking.
- Incorporate data from sensors and other sources to create a comprehensive understanding of the vehicle's environment, including other cars, pedestrians, traffic lights, and road signs.
- Optimize the vehicle's performance by developing algorithms for efficient route planning, fuel consumption, and traffic flow management.
- Ensure safety by implementing fail-safe mechanisms, emergency stop procedures, and error handling protocols.
- Test the system thoroughly in a variety of real-world driving conditions, and collect data to improve its accuracy and performance over time.

INTRODUCTION

- Self-driving vehicles were introduced in the US and were later criticized for their errors and unreliability.
  But we see autonomous vehicles as the future. Sooner or later improved technology is going to change our lives.

- Machines will imitate human behavior in unforeseen manner. But India due to its terrain, traffic and economy lacks in the autonomous vehicles segment.

- India needs to be ready for a revolution in the automobile industry. Infrastructure is going to remain the same at least for decades, our infrastructure like roads are well thought out for the Indian economy.

- Roads in rural parts of India are designed economically efficient, they were built without disturbing the local ecosystem. Also, due to weather conditions in India, roads are frequently damaged.

- Hence resulting in twists and turns. So we cannot expect major infrastructural change, but the autonomous vehicle technology is already there and is improving day by day. India needs to adapt this technology smartly by tweaking algorithms but not infrastructure.

SUMMARY OF THE LITERATURE SURVEY

- The literature survey for this project involved researching various topics related to self-driving cars and computer vision. The survey highlighted the importance of deep learning techniques such as convolutional neural networks (CNNs) for object recognition, lane detection, and behavior cloning. It also emphasized the use of real-time control systems such as Flask and Socket.io for communication between the car and server.
- Additionally, the survey covered the various levels of autonomous vehicles, including Level 0 (no automation) to Level 5 (full automation). It discussed the current state of the industry and the challenges that need to be addressed for the widespread adoption of self-driving cars.
- Furthermore, the survey explored the different software tools and libraries used in the project, such as Anaconda, NumPy, OpenCV, Keras, and TensorFlow. It also highlighted the importance of data preprocessing techniques such as image augmentation for improving the accuracy of deep learning models.
- Overall, the literature survey provided a comprehensive understanding of the state-of-the-art techniques and technologies used in self-driving cars and their applications. It helped to identify the gaps and opportunities for further research in this field.

PROBLEM STATEMENT

The problem statement of this project is to develop a self-driving car system using deep learning algorithms, that can operate on Indian roads and adapt to the driving psychology of Indian drivers. India is a unique environment for self-driving cars, as it presents several challenges such as unstructured and chaotic traffic, diverse road conditions, and unpredictable behavior of other drivers. The system must be capable of detecting and avoiding obstacles, navigating through complex intersections.

The objective is to develop a reliable and safe self-driving car system that can improve the efficiency and safety of transportation on Indian roads, reduce traffic congestion and provide a comfortable and convenient driving experience to passengers.

FUNCTIONAL REQUIREMENTS AND ASSUMPTIONS

- The self-driving car system will be able to plan and execute safe and efficient driving maneuvers, including lane changing, merging and turning.
- The self-driving car system will be able to detect and recognize traffic signs, traffic signals on the road.
- The self-driving car system will be able to detect pedestrians and other vehicles and successfully perform collision avoidance.
- The system will be able to accurately estimate the distance and speed of other objects on the road to avoid collisions.
- The system will be able to monitor and alert the driver in case of any failures or malfunctions.

Assumptions:

- The self-driving car system will operate on Indian roads with diverse road conditions and traffic patterns.
- The system will have access to high-resolution maps and real-time traffic information
- The system will use machine learning algorithms for decision-making and planning driving maneuvers. The system will have fail-safe mechanisms to ensure passenger safety in case of any system failures or malfunctions.
- The self-driving car system will require periodic maintenance and updates to ensure optimal performance and safety.

SOFTWARE USED

OpenCV :

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products.

Udacity simulation software :

Udacity Universe is a massive shared simulation environment where students develop and coordinate self-driving and self-flying vehicles to tackle the world's most complex mobility challenges. One of the most popular simulation software tools offered by udacity is the Udacity Self-Driving Car Simulator.

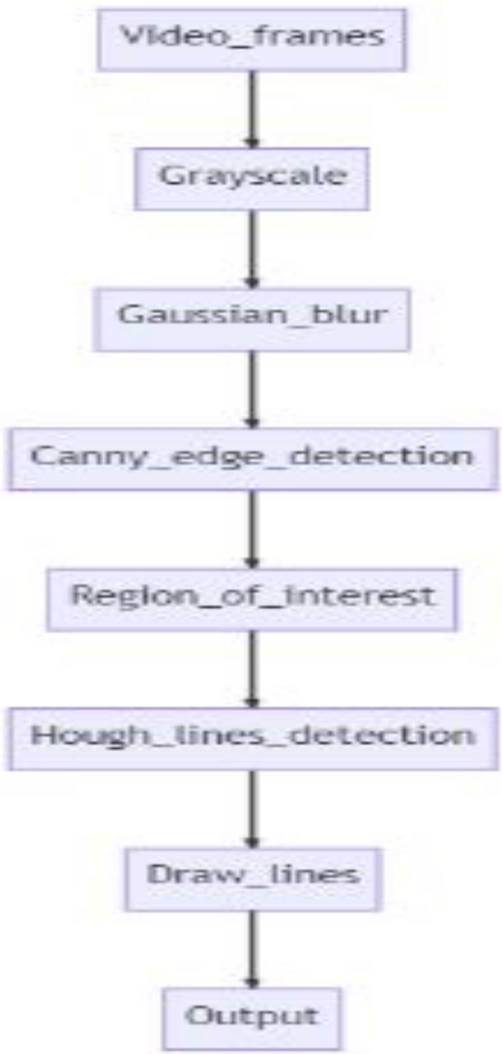
Jupyter Notebooks :

The Jupyter Notebook is the original web application for creating and sharing computational documents. It offers a simple, streamlined, document-centric experience.

Google colab :

Google Colab is simply an online representation of Jupyter Notebook. While Jupyter Notebook needs installation on a computer and can only use local machine resources, Colab is a full-fledged cloud app for Python coding. You can write Python codes using Colab on you Google Chrome or Mozilla Firefox web browsers.

METHODOLOGY



LANE DETECTION USING OPENCV

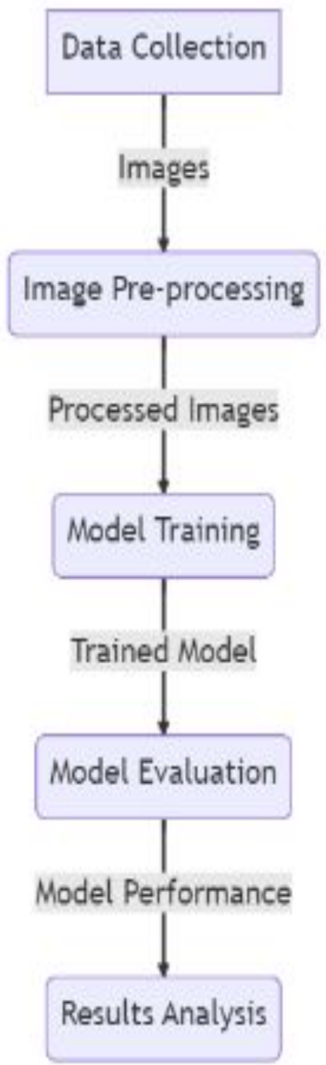
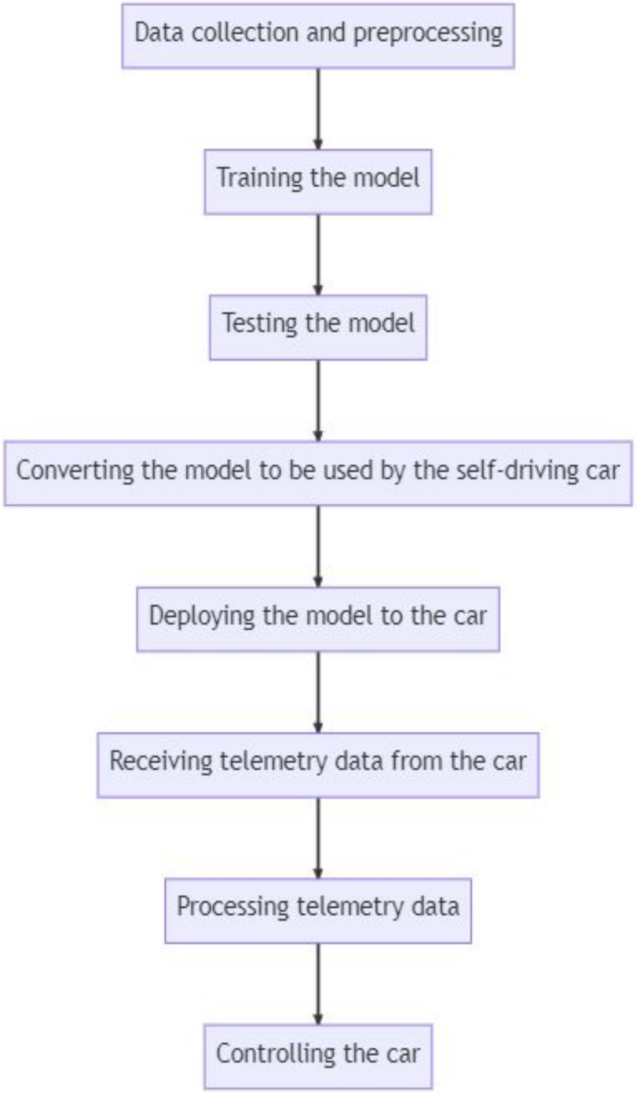
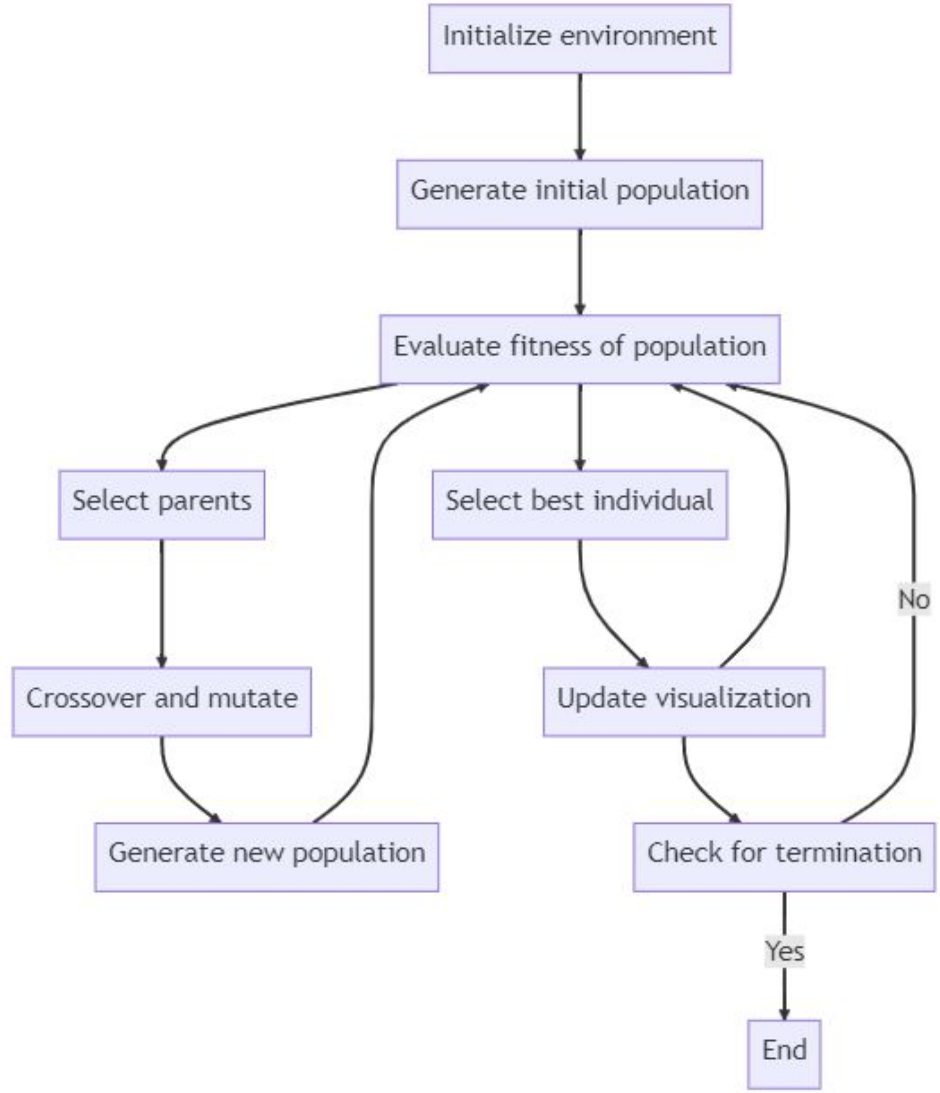


IMAGE RECOGNITION

METHODOLOGY



BEHAVIORAL CLONING



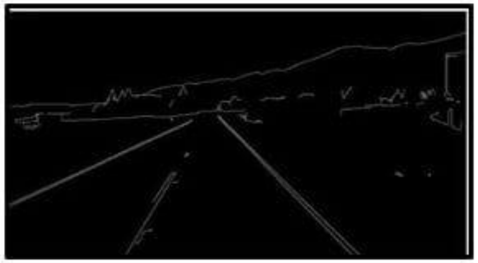
OBJECT DETECTION AND COLLISION AVOIDANCE

RESULTS AND ANALYSIS

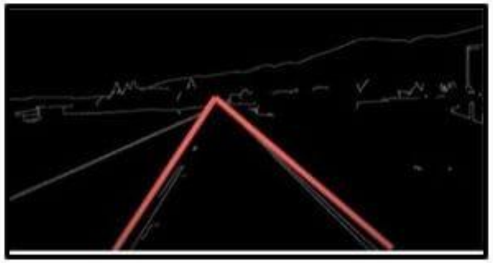
IMAGE

GRAY SCALE IMAGE

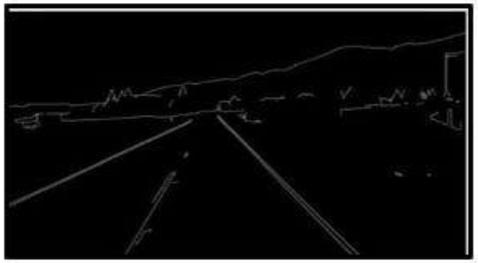
BLURRED GRAY SCALE IMAGE



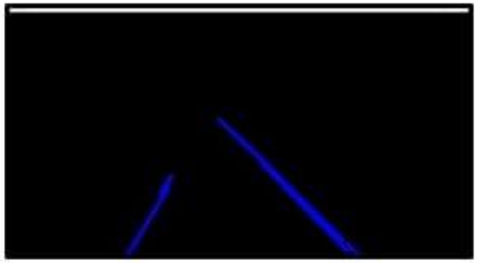
CANNY EDGE DETECTION IMAGE



REGION OF INTEREST



OUTPUT



HOUGH LINE DETECTION

OPTIMISED HOUGH LINE DETECTION

LANE DETECTED IMAGE

LANE DETECTION USING OPENCV

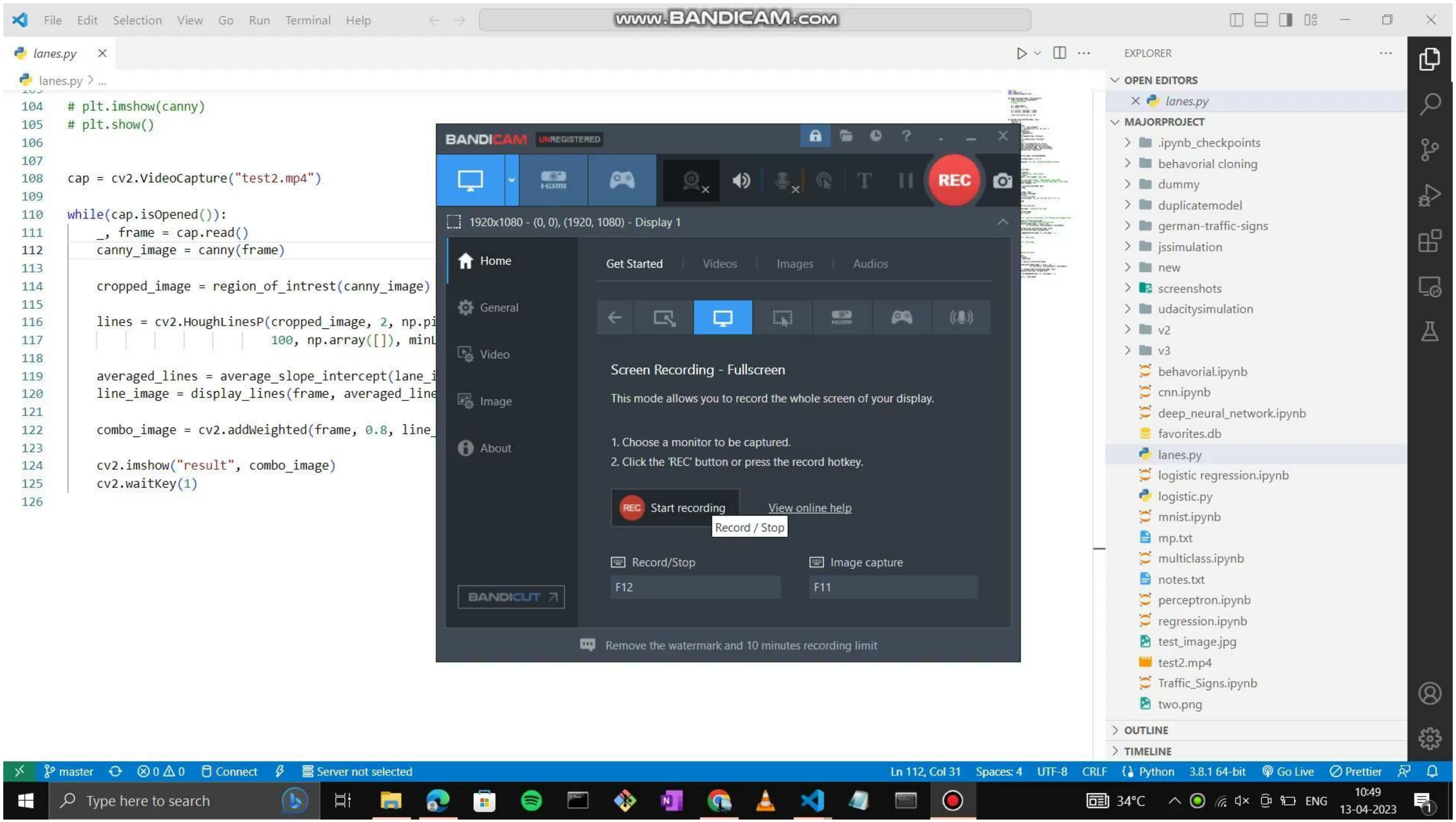
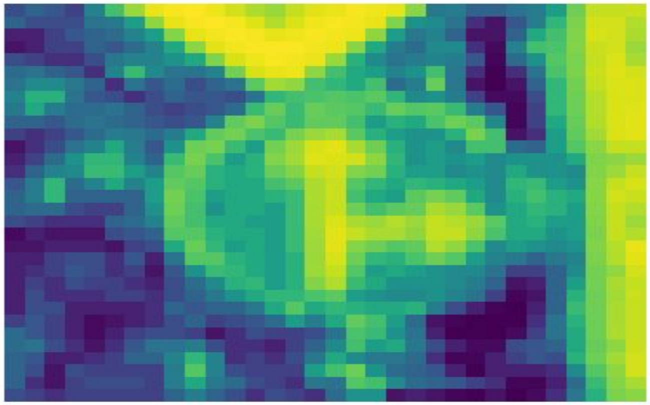


IMAGE RECOGNITION



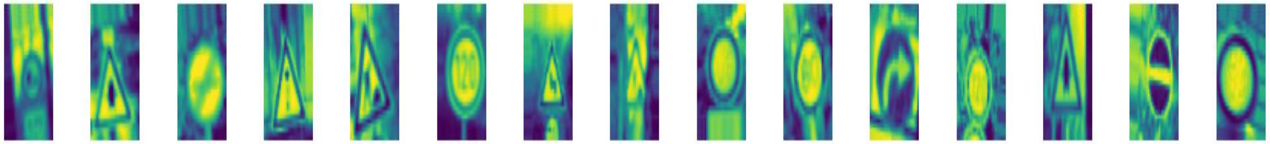


IMAGE RECOGNITION

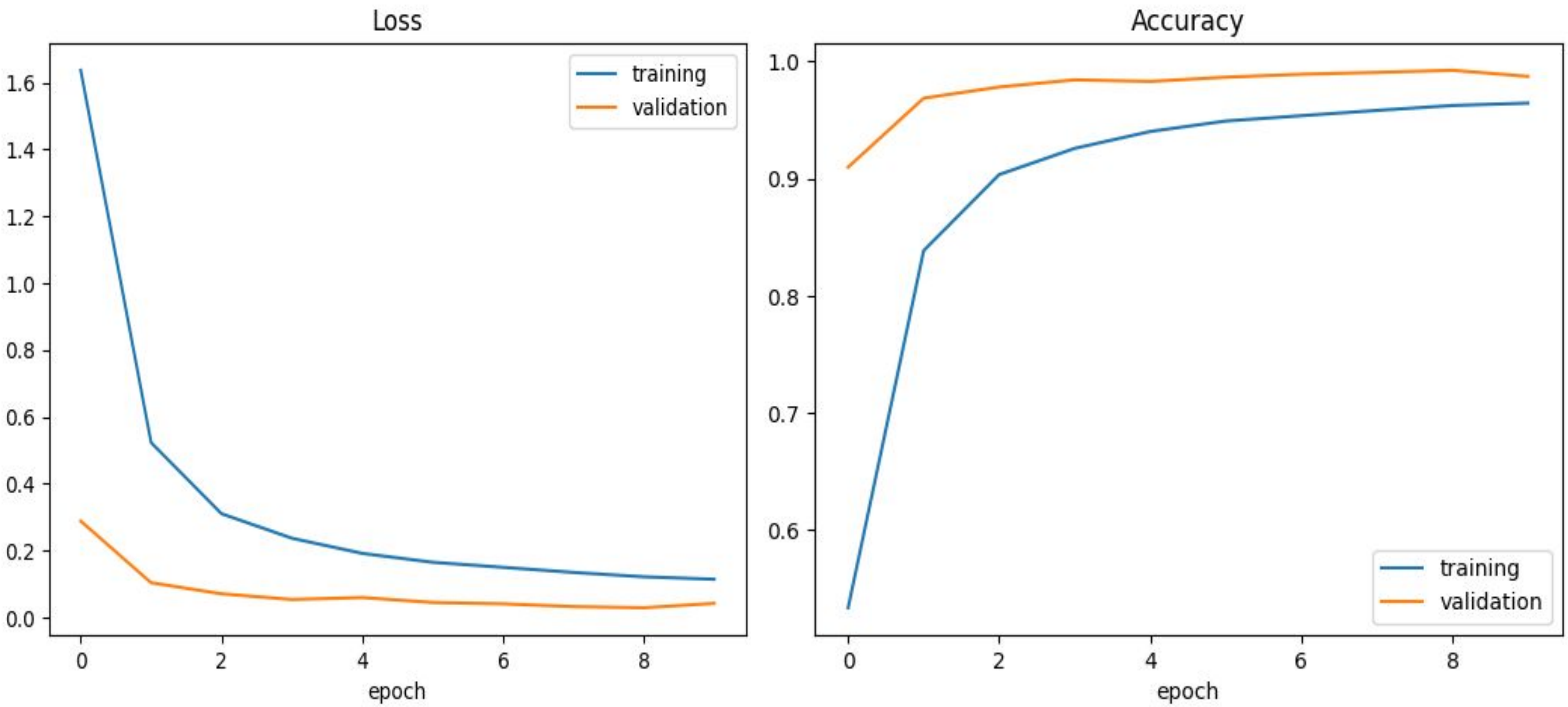


IMAGE RECOGNITION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predicted sign: [22]
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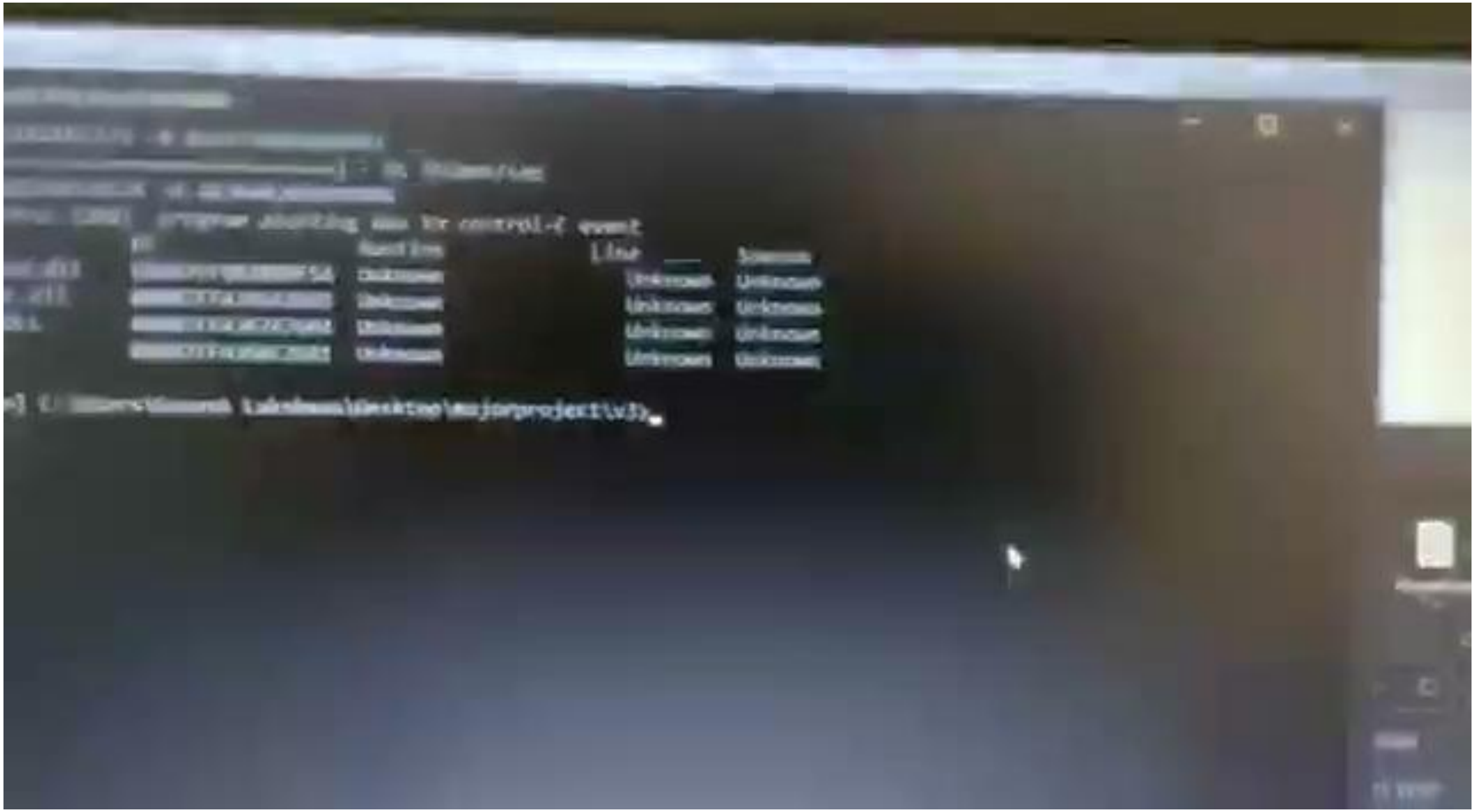
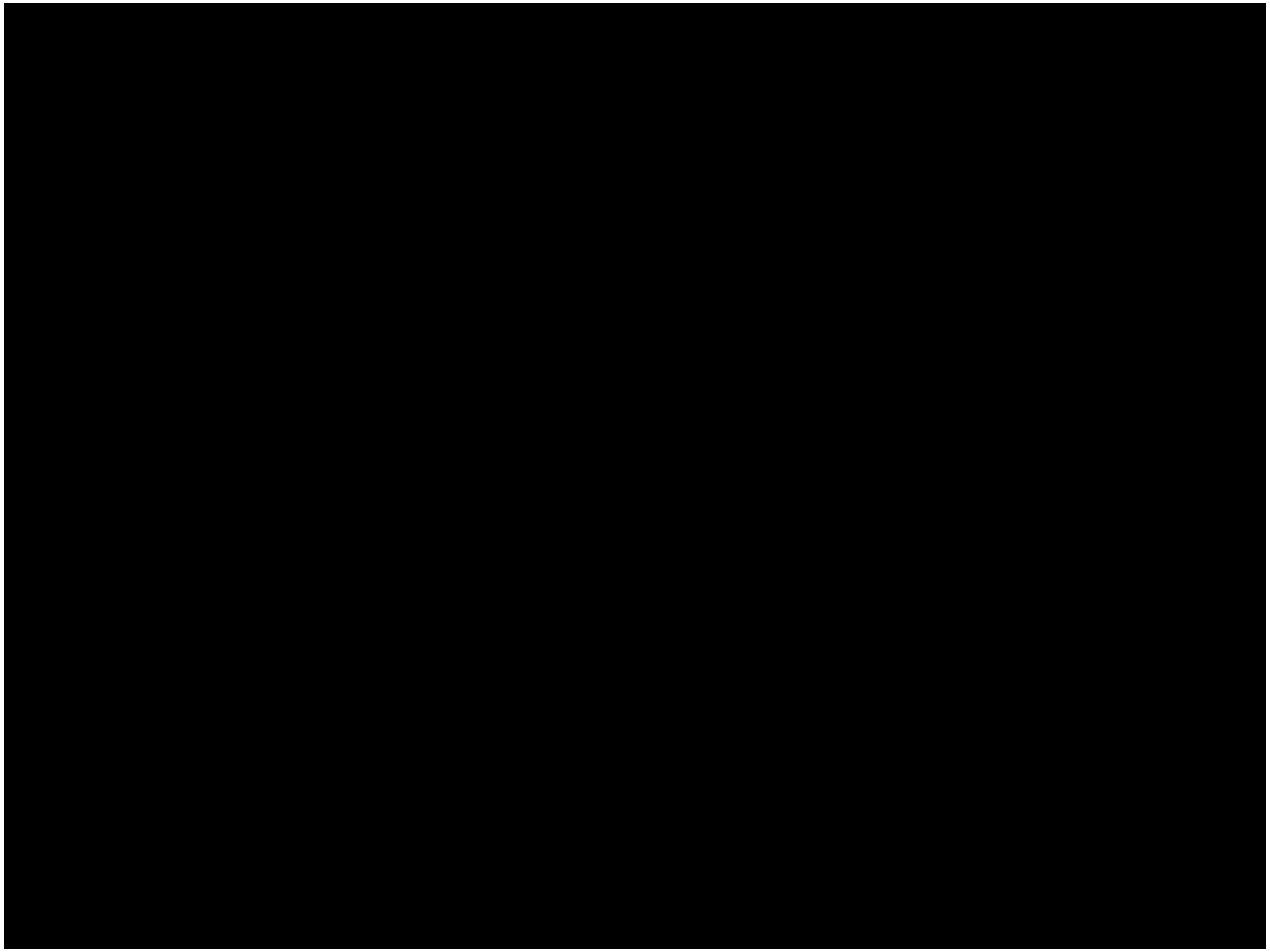
BEHAVIORAL CLONING



OBJECT DETECTION AND COLLISION AVOIDANCE



CONCLUSIONS

IN CONCLUSION, THIS PROJECT AIMED TO DESIGN AND IMPLEMENT A SELF-DRIVING CAR SYSTEM USING COMPUTER VISION AND DEEP LEARNING TECHNIQUES. THE PROJECT SUCCESSFULLY ACHIEVED ITS OBJECTIVES BY DEVELOPING AND FINE-TUNING CONVOLUTIONAL NEURAL NETWORKS FOR IMAGE RECOGNITION AND LANE DETECTION, TRAINING A DEEP NEURAL NETWORK FOR BEHAVIOR CLONING, AND IMPLEMENTING REAL-TIME CONTROL USING FLASK AND SOCKET.IO FOR COMMUNICATION BETWEEN THE CAR AND SERVER.

THE PROJECT ACHIEVED HIGH ACCURACY RATES IN IMAGE RECOGNITION AND LANE DETECTION TASKS, AND THE KNOWLEDGE GAINED IN COMPUTER VISION, DEEP LEARNING, AND AUTONOMOUS SYSTEMS CAN BE APPLIED TO FURTHER DEVELOP THE TECHNOLOGY FOR FUTURE SELF-DRIVING VEHICLES. OVERALL, THE PROJECT WAS A SUCCESS AND DEMONSTRATED THE POTENTIAL FOR SELF-DRIVING CARS TO REVOLUTIONIZE THE TRANSPORTATION INDUSTRY.

FUTURE SCOPE

The Society Of Automotive Engineers (SAE) Has Defined Six Levels Of Autonomous Driving, From Level 0 To Level 5, Based On The Amount Of Human Intervention Required.

Level 0: No Automation: The Driver Is Responsible For All Aspects Of Driving.

Level 1: Driver Assistance: The System Can Control Either The Acceleration Or The Steering, But Not Both Simultaneously. The Driver Is Responsible For All Other Aspects Of Driving.

Level 2: Partial Automation: The System Can Control Both The Acceleration And The Steering Simultaneously, But The Driver Must Remain Alert And Ready To Take Control At Any Time.

Level 3: Conditional Automation: The System Can Take Full Control Of The Vehicle In Certain Situations, But The Driver Must Be Prepared To Intervene If The System Encounters A Scenario It Cannot Handle.

Level 4: High Automation: The System Can Take Full Control Of The Vehicle In Most Driving Scenarios, And The Driver Is Not Required To Be Constantly Alert.

Level 5: Full Automation: The System Can Handle All Driving Scenarios, And There Is No Need For A Driver At All.

FUTURE SCOPE

As Of Now, Most Autonomous Vehicles Are At Level 2 Or Level 3, Which Means That They Still Require Human Intervention In Certain Situations. However, There Is Ongoing Research And Development To Achieve Level 4 Or Level 5 Autonomy, Which Would Mean That The Vehicle Is Capable Of Operating Without Any Human Input.

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THANK YOU