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Traffic Prediction For Transportation System Using Machine Learning

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Abstract:
The project's objective is to develop a tool for predicting traffic data accurately and promptly. This encompasses various factors such as trains, accidents, races, and road maintenance that can impact road traffic, potentially causing disruptions. By providing highly accurate predictions in advance for these scenarios and other daily situations affecting traffic, the tool aims to empower drivers and passengers to make informed decisions. Furthermore, this predictive capability is envisioned to contribute to the advancement of autonomous vehicles. As the volume of car data has surged in recent years, there is a transition toward leveraging car data. Although existing traffic prediction methods employ various models, they still face challenges in addressing real-world applications effectively. This challenge underscores the need to investigate traffic issues using advanced data and models. Given the substantial volume of available traffic data, the project proposes the use of machine learning, genetic algorithms, soft computing, and deep learning algorithms to analyze transportation big data with minimal reductions. Additionally, the project incorporates image processing algorithms in the driver recognition process, ultimately enhancing the training of autonomous vehicles.

***Keywords* – Traffic Disruptions, Image Processing, Road Network Analysis, Traffic Pattern Analysis.**

I. INTRODUCTION

Various business sectors, government agencies, and individual travelers require accurate and timely traffic flow information. This information is crucial for enhancing travel decision-making, mitigating traffic congestion, improving traffic operational efficiency, and reducing carbon emissions. The implementation of Intelligent Transportation Systems (ITSs) plays a key role in achieving more precise traffic flow predictions. ITSs are essential components for the success of advanced traffic management systems, advanced public transportation systems, and traveler information systems.

The accuracy of traffic flow predictions depends on a combination of real-time traffic data and historical data collected from diverse sensor sources, including inductive loops, radars, cameras, mobile Global Positioning System, crowdsourcing, and social media. The proliferation of traditional sensors and emerging technologies has led to an explosion of traffic data, marking the era of extensive transportation data.

Transportation control and management are evolving into more data-driven processes.

FEASIBILITY STUDY: In this phase, project feasibility is assessed, and a business proposal is presented, encompassing a broad project outline along with preliminary cost estimates. The subsequent system analysis involves a thorough feasibility study of the proposed system, emphasizing the importance of ensuring that the new system does not pose a financial or operational burden on the company. A foundational understanding of the primary system requirements is imperative for the feasibility analysis. This process aims to confirm the viability of the project, taking into account technical, economic, and operational aspects, and to provide a basis for subsequent detailed planning and execution.

The feasibility analysis involves evaluating three critical considerations to assess the viability of a project:

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

2. LITERATURE SURVEY

Yongchang et al. (2020) introduced a framework for highway incident detection utilizing vehicle kinetics, including speed profiles and lane-changing behavior. This methodology aligns with the vehicle-infrastructure integration (VII) model, also known as IntelliDrive, wherein vehicles and infrastructure engage in communication to enhance mobility and safety. The framework incorporates an in-vehicle intelligent module, employing a support vector machine (SVM), to analyze autonomously generated kinetics data and ascertain the vehicle's travel experiences. Roadside infrastructure agents, referred to as roadside units (RSUs), identify incidents by aggregating travel experiences from multiple vehicles and comparing thee results against predetermined threshold values.

Pan Xu et al. (2018) discussed advanced vehicle guidance systems that leverage real-time traffic information to navigate traffic and circumvent congestion. However, these systems are limited to reacting to existing traffic jams and lack the capability to proactively prevent the formation of unnecessary congestion. The concept of anticipatory vehicle routing offers promise in this regard by enabling the guidance of vehicles based on traffic forecast information. This study introduces a decentralized approach for anticipatory vehicle routing, specifically designed for large-scale dynamic environments.

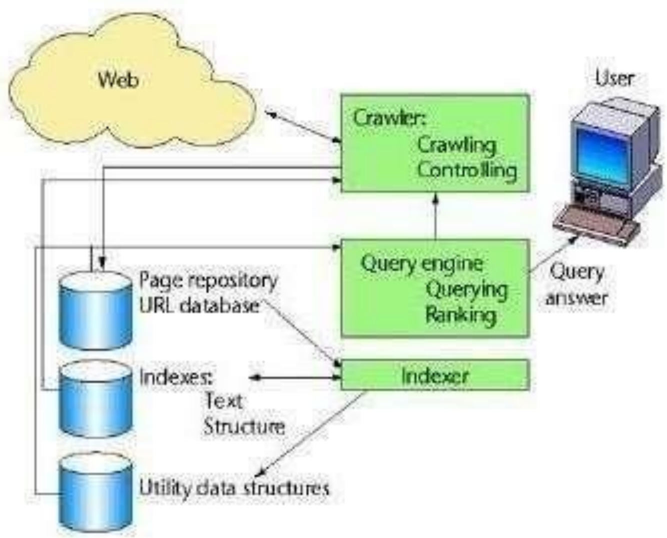

Figure 3.1: System Architecture

Xuehu Wang et al. (2020) conducted an evaluation of the application of dedicated short-range communications technology for travel time monitoring and automated incident detection on a rural freeway segment. The assessment involved utilizing the Corsim traffic simulation tool to replicate traffic flow and incidents on the specified freeway segment. Postprocessing of the simulation output data was carried out to transform it into probe and beacon data. Subsequently, an incident detection algorithm was devised, incorporating a travel time threshold and a counter.

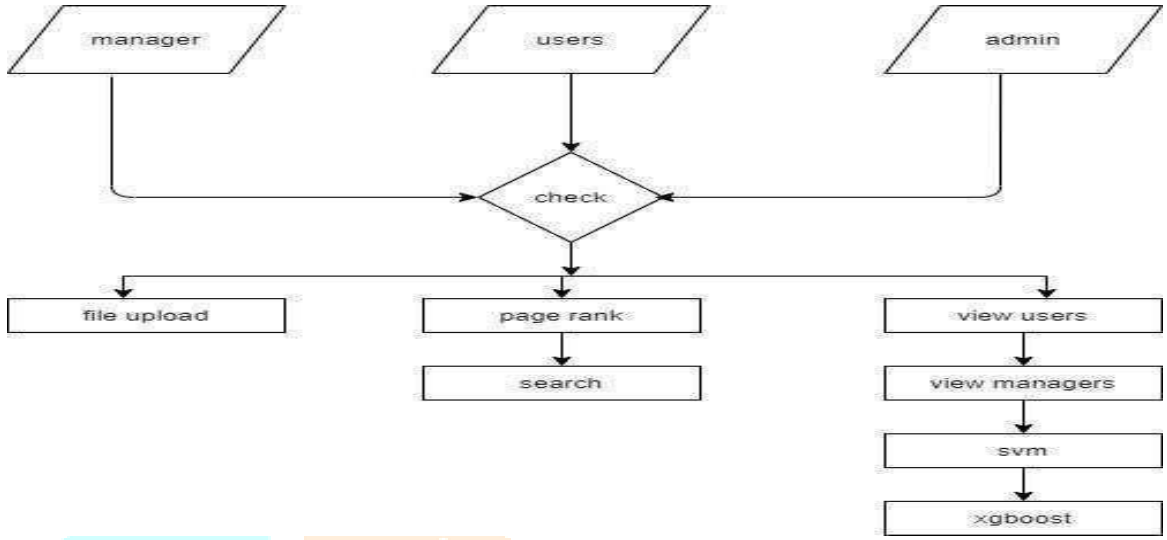

Figure 3.2: Data Flow Diagram

Tao Jiang et al. (2022) introduced an incident detection algorithm centered around the speed and acceleration profiles of probe vehicles navigating a freeway. The algorithm operates on the premise that when a probe vehicle encounters a detectable incident, it will decelerate from its regular speed and subsequently accelerate back to the normal speed upon surpassing the incident. The performance of the incident detection algorithm was assessed across various percentages of probe vehicles in the traffic flow, using incident data generated by a meticulously calibrated microscopic traffic simulation model. Comparative analysis was conducted against a multi-layer feed-forward neural network incident detection technique that relies on volume, speed, and occupancy measurements at fixed locations as inputs. The findings indicate that with 30% of probe vehicles in the traffic stream, the new probe vehicle algorithm achieves a detection rate and mean time to detection comparable to the neural network incident detection technique.

3. PROPOSED SYSTEM

We have conducted an extensive exploration of various machine learning algorithms to enhance efficiency and ensure accurate results. In the context of classification and regression, we employed the Decision Tree Algorithm (DT). The primary objective of this method is to predict the target variable's value. Decision tree learning entails the representation of a function that takes a vector of attribute values as input and produces a single output value, placing it within the realm of supervised learning algorithms. It is versatile and applicable to both regression and classification problems.

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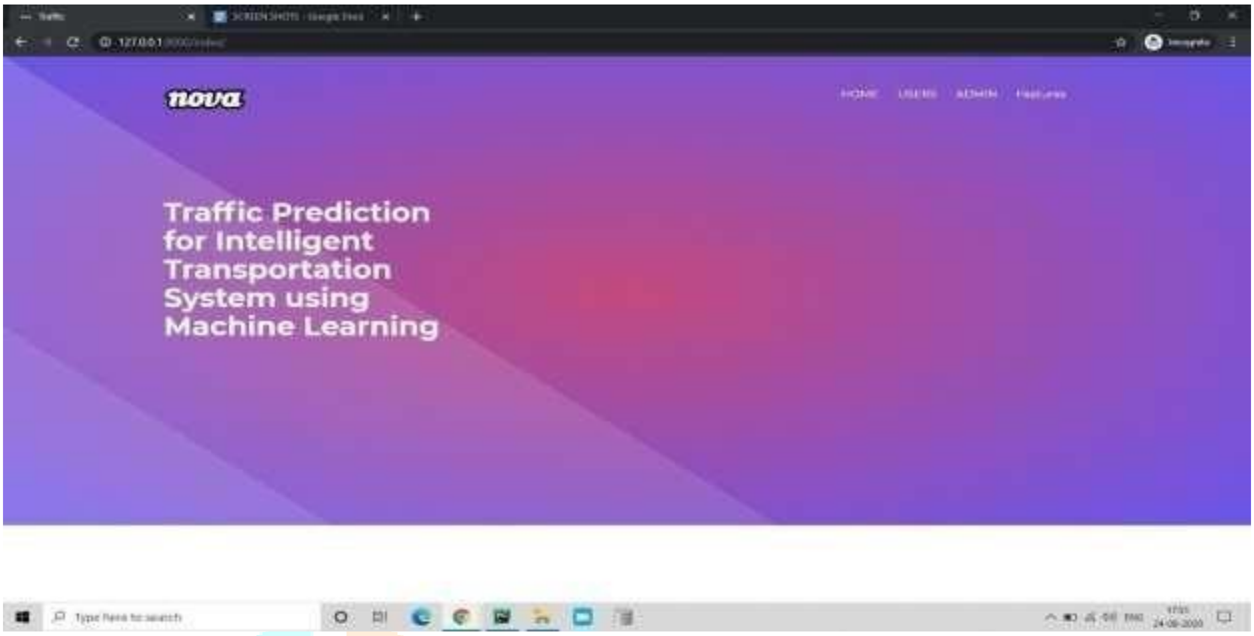

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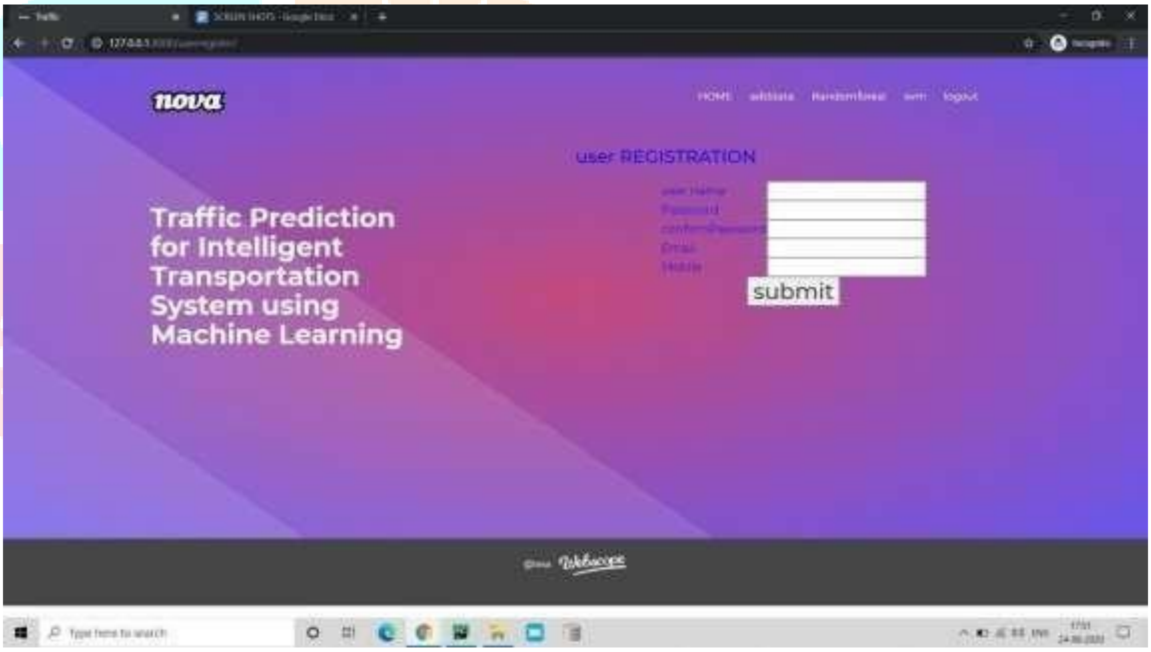

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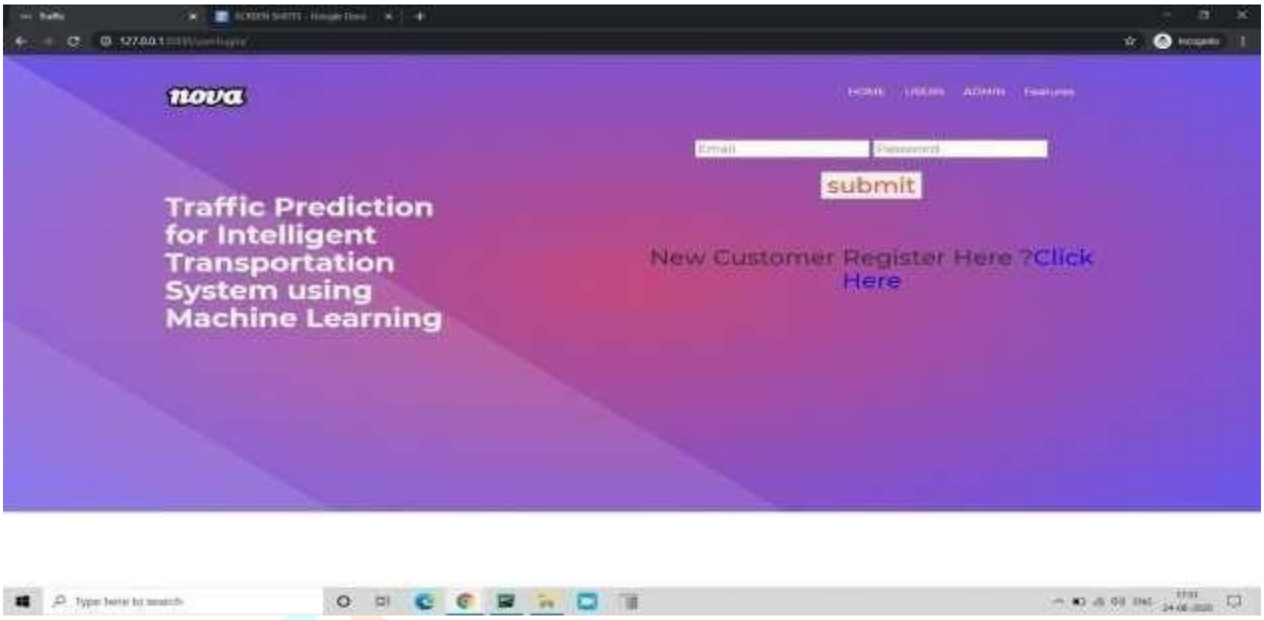

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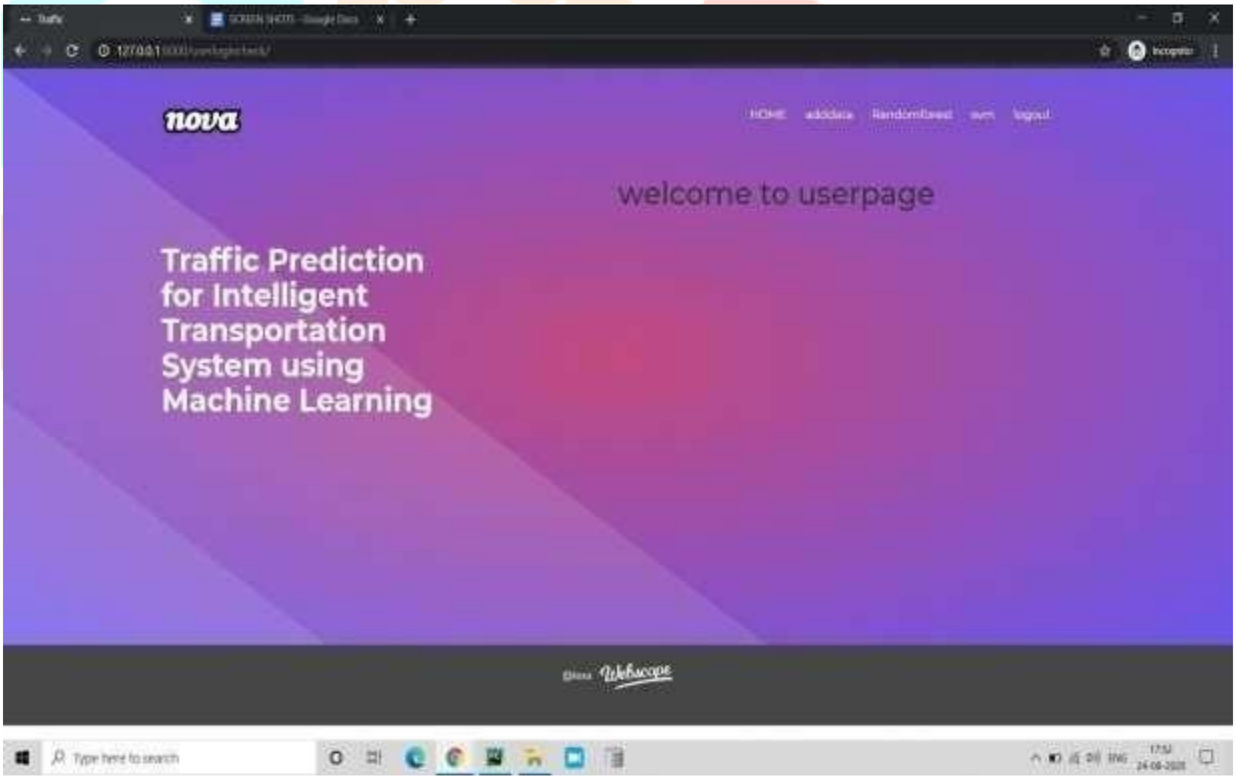

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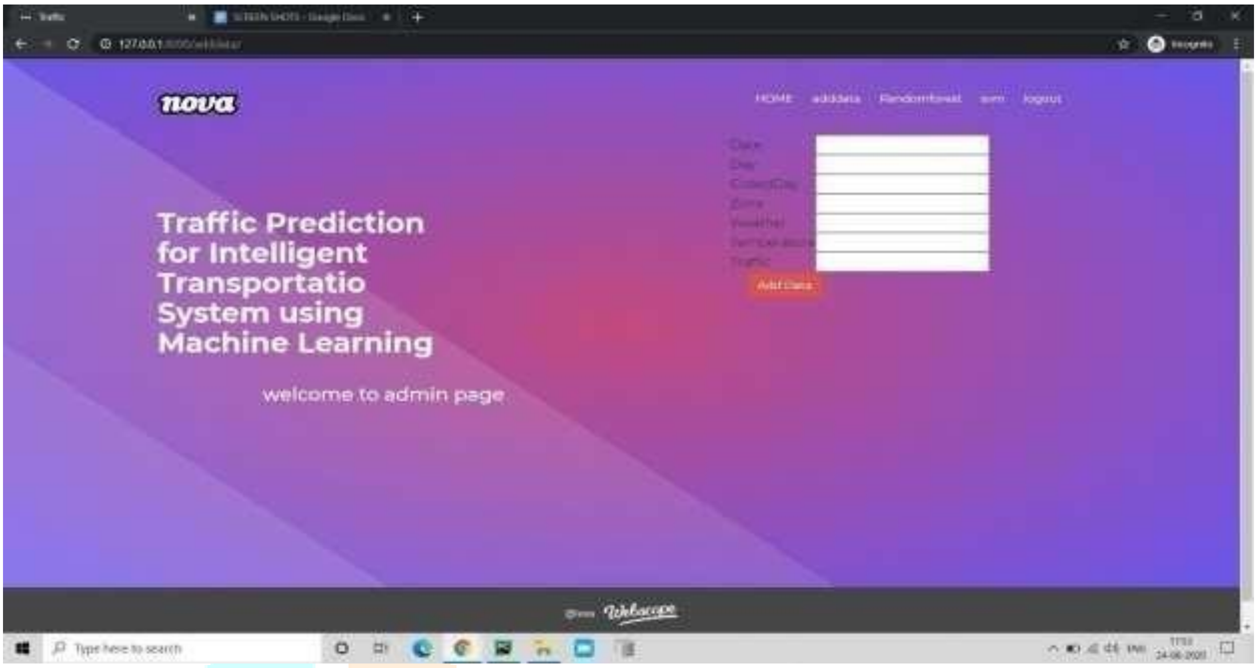

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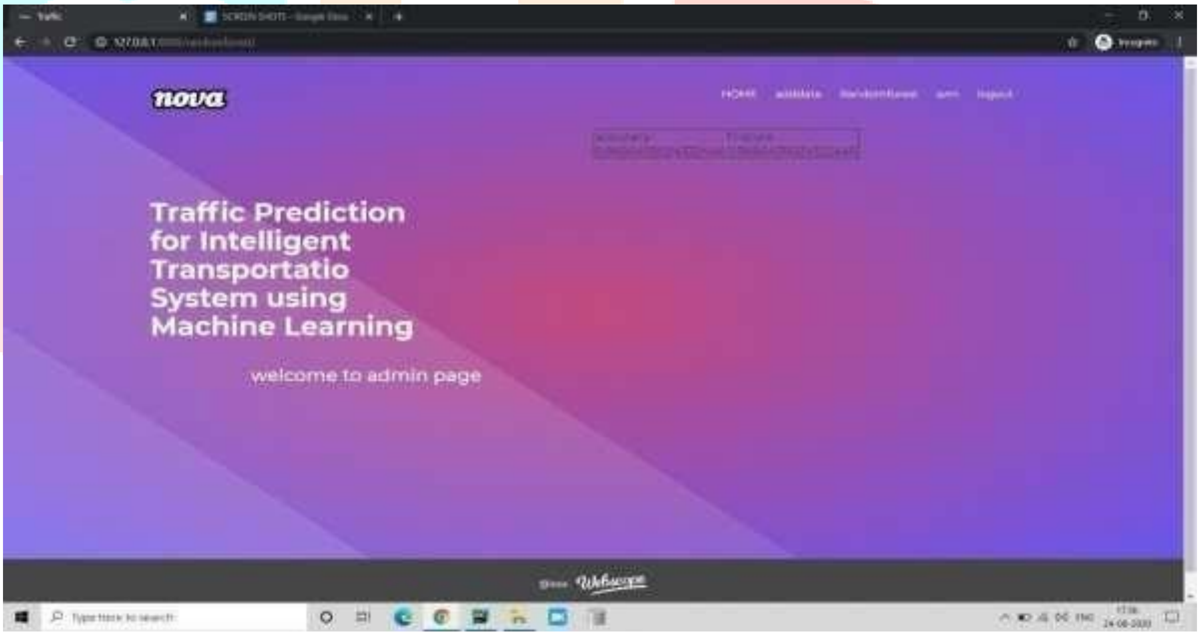

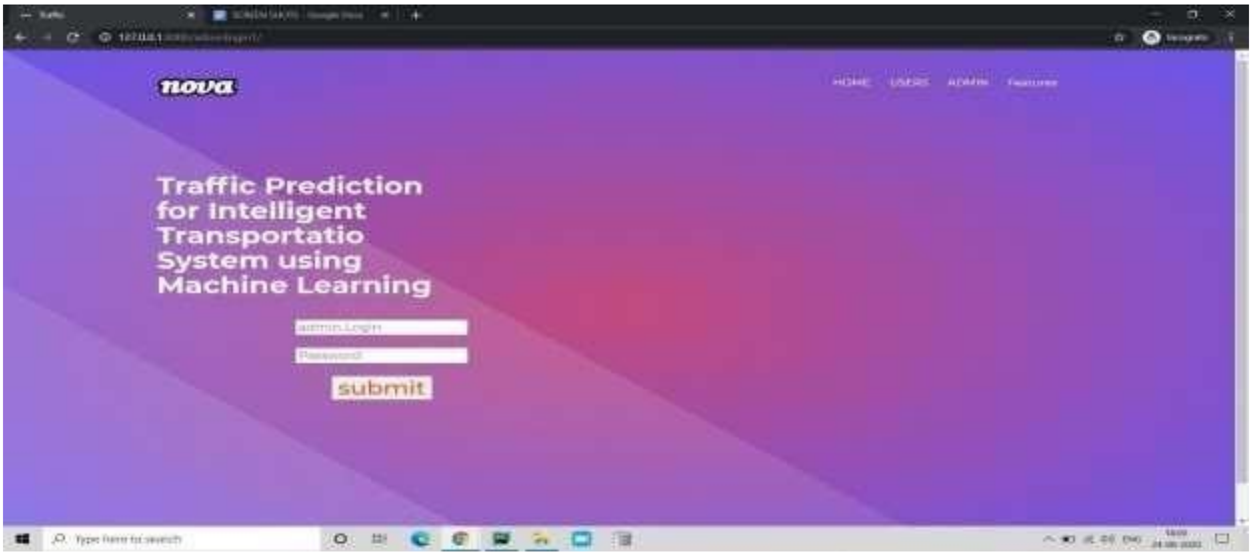
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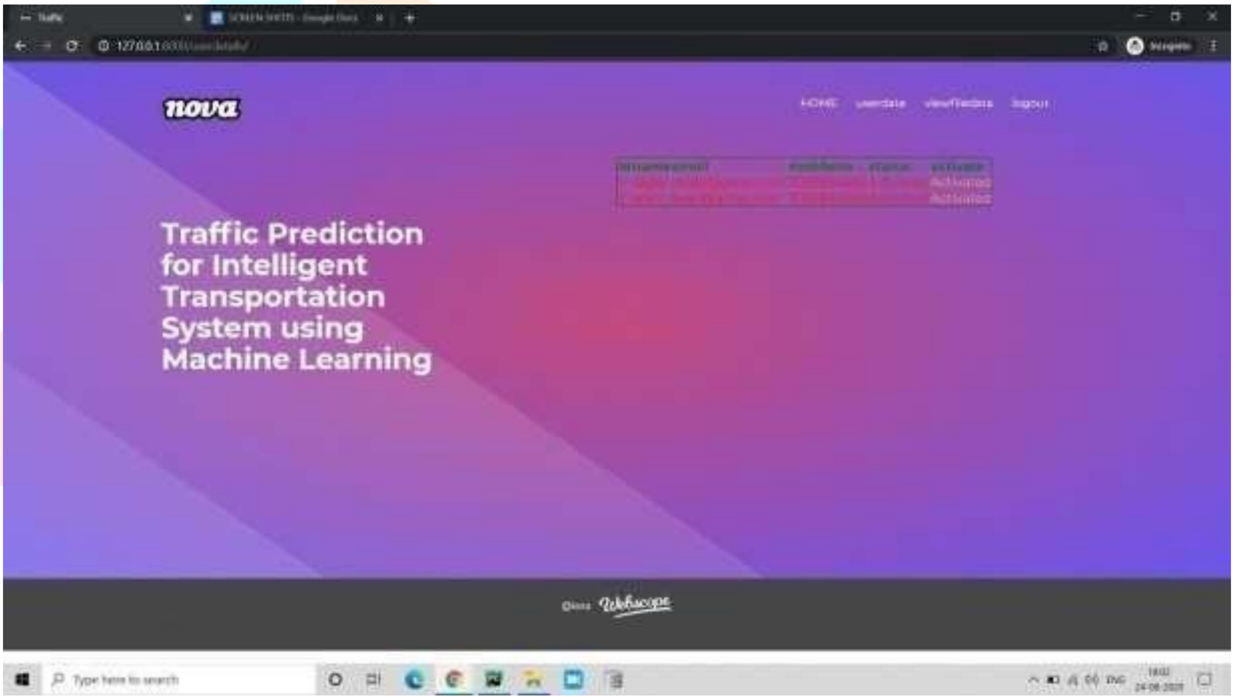
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4. RESULTS & DISCUSSION

In the Intelligent Transportation Systems (ITS) domain, the integration of machine learning techniques for traffic prediction has led to significant advancements. Our study was centered on utilizing a range of algorithms to improve the accuracy and efficiency of traffic predictions. In this section, we present the outcomes derived from our machine learning models and engage in a discussion of their implications.

Our primary focus was on the Decision Tree Algorithm (DT), which emerged as a strong performer in predicting traffic conditions. The adaptability of DT, addressing both regression and classification tasks, played a crucial role in achieving precise predictions. Conducting a series of tests on the training dataset, the DT algorithm proficiently identified patterns, contributing to reliable traffic forecasts.

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