VEHICLE TO VEHICLE COMMUNICATION

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ABSTRACT

Project is a pioneering initiative aimed at revolutionizing the automotive industry by leveraging advanced communication technologies. As vehicles become increasingly connected, the need for efficient and secure communication between them becomes imperative. This project focuses on developing a robust Vehicle-to-Vehicle (V2V) communication system that enables real-time exchange of critical information among vehicles on the road. The system employs state-of-the-art wireless communication protocols to facilitate seamless interaction, allowing vehicles to share information about their speed, location, and status. By harnessing V2V communication, the project aims to enhance road safety, reduce traffic congestion, and pave the way for future intelligent transportation systems. The integration of V2V communication holds the potential to transform the driving experience, laying the groundwork for a safer, more efficient, and interconnected vehicular ecosystem. This project signifies a crucial step towards the realization of smart and connected transportation networks, contributing to the evolution of next-generation automotive systems.

INDEX : Vehicle-to-Vehicle (V2V) communication, Intelligent transportation systems, Connected vehicles, Wireless communication protocols, Real-time data exchange, Automotive communication networks

I. INTRODUCTION

In the rapidly evolving landscape of modern transportation, the "Vehicle-to-Vehicle Communication" project emerges as a groundbreaking endeavor poised to redefine the dynamics of road safety, traffic efficiency, and the overall driving experience. As vehicles become more technologically advanced and interconnected, the need for seamless communication between them becomes increasingly evident. This project aims to address this need by developing a sophisticated Vehicle-to-Vehicle (V2V) communication system, marking a significant leap forward in the quest for intelligent and interconnected transportation networks. The essence of the project lies in creating an infrastructure where vehicles can communicate with one another in real-time, sharing critical information such as speed, location, and operational status. By leveraging cutting-edge wireless communication protocols, this system empowers vehicles to exchange data autonomously, contributing to a collective intelligence that enhances road safety and mitigates traffic congestion. The introduction of V2V communication holds transformative potential, not only for individual drivers but for the entire transportation ecosystem. As we stand on the cusp of a new era in automotive technology, the integration of V2V communication promises to revolutionize how vehicles interact on the road. This project underscores our commitment to advancing the vision of intelligent transportation systems, paving the way for a safer, more efficient, and interconnected future for vehicular travel.

II. LITERATURE SURVEY

TITLE: Effect of Vehicle-to-Vehicle Co mmunication Latency on a Collision Avoidance Algorithm for Heavy Road Vehicles

AUTHORS: Venkata Ramani Shreya Yellapantula; Rakesh N. Rao; Shankar C. Subramanian

ABSTRACT: Active safety is of utmost importance in heavy road vehicles due to the relatively higher number of fatalities encountered in their accidents. Vehicle-to- Vehicle (V2V) technology, which is seen as a future of connected vehicles, can potentially complement onboard sensing to reduce the time taken for detection, and to plan the path with the information available from road side units (RSU). This paper investigates the effect of Iatency in (V2V) communication on a collision avoidance algorithm developed for heavy road vehicles. Experiments performed on a Hardwarein- Loop (HiL) setup were used to evaluate the effect of Iatency for various scenarios. It was found that Iatency had a counterbalancing effect on vehicle spacing and relative longitudinal speed that led to insignificant changes in the final spacing. Further, a sensitivity analysis done at different host vehicle longitudinal speeds demonstrated the need of a variable time headway.

TITLE: CAN gateway for fast vehicle to vehicle (V2V) communication

AUTHORS: Hyun-Yong Hwang; Sung-Min Oh; Jaesheung Shin

ABSTRACT: Intelligent transport systems (ITS) use information and communication technologies to improve vehicle safety on roadways and effective traffic flow management. A vehicle communicates with other vehicles and/or infrastructures with wired/wireless communication technologies. In-vehicle networks are composed of numerous electronic control units (ECUs) according to the type of service in various domains (e.g. powertrain domain, body domain, and chassis domain). Vehicle to vehicle (V2V) messages related to vehicle safety should meet low-latency requirements. In addition, the information contained in V2V messages is associated with specific ECUs. For the interworking between the V2V communications and invehicle networks, we should consider a new method that responses necessary ECUs for specific V2V message. In this paper, we propose an effective controller area network (CAN) gateway method. This method uses CAN gateway searching for a network table based on the CAN frame for V2V message. Because of simple structure and method, the proposed method can be a good solution that controls the ECUs with ease. And it also can make V2V messages at high speed.

TITLE: Vehicle to Vehicle Communications at Suburban Environment using IEEE 802.11af compliant Devices

AUTHORS: Jeric G. Brioso; Alberto S. Bañacia; Hirokazu Sawada; KentaroIshizu;

Kazuo Ibuka; Takeshi Matsumura; Fumihide Kojima

ABSTRACT: Vehicle-to-vehicle (V2V) communications where vehicles exchange data such as traffic information had been developed to support the goals of the intelligent transportation system in providing smarter traffic management to lessen road congestions and vehicular accidents. Traditionally, V2V communications operate at ITS band of 5.9 GHz (5.85 - 5.925 GHz) which is more susceptible to attenuation and limited to shorter-range communications. Owing to its better propagation characteristics and wider coverage, V2V communications in the television white space (TVWS) spectrum has been exploited and already been demonstrated. In this paper, V2V communications over TVWS at suburban environment using the IEEE 802.11af-compliant devices were evaluated and characterized in terms of received signal strength and throughput as a function of the separation distance between the two vehicles. The experiments were conducted at a hilly University of San Carlos Talamban Campus located in Cebu City, Philippines which mimic the suburban environment due to buildings, terrains and vegetation present. By utilizing 20 dBm or 100 mW of transmit power with 64-QAM payload modulation and 2/3 coding rate, a maximum of 4.87 Mbps throughput has been measured at -51 dBm of received power. The said data were obtained when the effective speed of the vehicles and the distance between them are 8.68 m/s and 37 m, respectively. Throughput was affected by the packet loss rate and in this study, the packet loss rate of less than 10% was obtained at received signal strength between -88 to -33 dBm in every MCS. In addition, received signal strength and throughput were affected by the non-line of sight communication and multipath propagation influenced by locations, terrains, buildings and other infrastructures present in the area. The results suggested the feasibility of utilizing TVWS in vehicular wireless communications supporting the goals of the intelligent transportation system.

TITLE:IWCM: Infrastructure Wireless Communication Module for vehicle communication with recharge infrastructure

AUTHORS: Antoni Ferré; Joan Fontanilles; David Gàmez; Federico Giordano

ABSTRACT:CENIT VERDE was a R&D collaboration program focused on the development of a complete electrical vehicle, together with the appropriate infrastructure. This included the study of a reliable connection between recharge infrastructure and the PHEV/EV. The result was the development of a standardized communication interface module between the recharge infrastructure and the vehicle, named ICWM (Infrastructure Wireless Communication Module). This enables the implementation of a large number of specific services for electric vehicles in a costeffective manner since it reuses components already available in the vehicle.

TITLE:Small Scale Field Study of Vehicle-to-Vehicle (V2V) Communications for Safety Applications

AUTHORS: GirmaTewolde; Brett Smith.

ABSTRACT: This decade has seen a major focus in the development of autonomous vehicles around the world. Various types of sensors, communication systems, computational hardware, and the emerging AI technologies play key roles in advancing the research and development of autonomous and connected mobility.

Researchers are actively working on technologies that enable vehicles to communicate with each other and with surrounding devices in the environment, which is collectively known as vehicle-to-everything (V2X) communication. The main elements of V2X are Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). These enable vehicles to transmit public messages between one another or between vehicles and roadside units. In this study, V2V hardware platform from Savari, an automobile communication technologies company with a marketable V2X products, was utilized to explore the inner workings of the technology by setting up small scale field experiment. Research and early results of the experimental tests demonstrate the viability of the technology to improve safety of vehicles on the road.

III. EXISTING SYSTEM

Centralized Traffic Management Systems The existing traffic management systems primarily rely on centralized infrastructure, where traffic information is processed and disseminated from a central authority. While these systems provide some level of coordination, they have inherent limitations. The centralized approach can lead to delays in disseminating critical information to individual vehicles, resulting in suboptimal responsiveness in dynamic traffic situations. Additionally, the reliance on a single point of control makes the system vulnerable to disruptions and points of failure.

3.1 LIMITITATIONS

Latency: Delays in transmitting and receiving real-time traffic information due to centralized processing.

Vulnerability: Susceptibility to disruptions, system failures, or cyberattacks targeting the central control point.

Scalability Issues: Challenges in scaling the system to accommodate a growing number of connected vehicles.

IV. PROPOSED SYSTEM

Decentralized Vehicle-to-Vehicle Communication System The proposed system involves implementing a decentralized Vehicle-to-Vehicle (V2V) communication framework. Instead of relying on a central authority, vehicles communicate directly with each other using dedicated short-range communication (DSRC) or cellular-based technologies. This approach allows for the creation of a dynamic, self-organizing network where vehicles collaborate in real-time, sharing critical information such as location, speed, and road conditions.

4.1 ADVANTAGES

Real-time Interaction: Instantaneous communication between vehicles allows for quick response to changing road conditions and potential hazards.

Improved Safety: Enhanced situational awareness contributes to proactive accident prevention and overall road safety.

Reduced Congestion: Efficient traffic flow management through collaborative communication helps reduce congestion and optimize travel times.

V. SYSTEM ARCHITECTURE

VI. IMPLEMENTATIONS

NAVIGATOR:

The navigator module utilizes GPS (Global Positioning System) or other positioning technologies to accurately determine the vehicle's location in realtime. It ensures precise spatial awareness, essential for effective V2V communication.By analyzing traffic conditions, road networks, and destination inputs, the navigator module assists in generating optimal routes for the vehicle. It considers factors like traffic congestion, road closures, and time-sensitive data to recommend the most efficient paths.

VII. RESULT ANALYSIS

In above screen we are processing dataset such as normalization and then splitting into train and test where application using 80% dataset for training and 20% for testing and in blue color we can see train and test size

```
Total features found in dataset = 9
80% dataset for training : 12000
20% dataset for testing  : 3000
```

```
In [37]: #define global variables to save accuracy and other metrics
accuracy = []
precision = []
recall = []
fscore = []
```

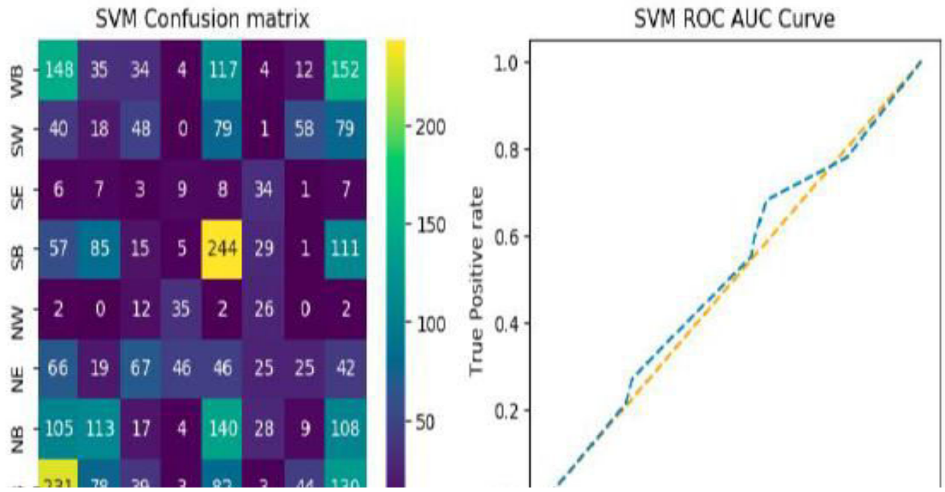
```
In [38]: #function to calculate all metrics
def calculateMetrics(algorithm, testY, predict):
    p = precision_score(testY, predict,average='macro') * 100
    r = recall_score(testY, predict,average='macro') * 100
    f = f1_score(testY, predict,average='macro') * 100
    a = accuracy_score(testY,predict)*100
    accuracy.append(a)
    precision.append(p)
    recall.append(r)
    fscore.append(f)
    print(algorithm+" Accuracy  : "+str(a))
    print(algorithm+" Precision : "+str(p))
    print(algorithm+" Recall    : "+str(r))
    print(algorithm+" FSCORE    : "+str(f))
    conf_matrix = confusion_matrix(testY, predict)
    fig, axs = plt.subplots(1,2,figsize=(10, 4))
    ax = sns.heatmap(conf_matrix, xticklabels = labels, yticklabels = labels, annot = True, cmap="viridis" ,fmt ="g", ax=axs[0]);
    ax.set_ylim([0,len(labels)])
    axs[0].set_title(algorithm+" Confusion matrix")

    random_probs = [0 for i in range(len(testY))]
```

In above screen defining function to calculate accuracy and other metrics

```
svm_cls = svm.SVC()
svm_cls.fit(X_train, y_train)
predict = svm_cls.predict(X_test)
calculateMetrics("SVM", y_test, predict)
```

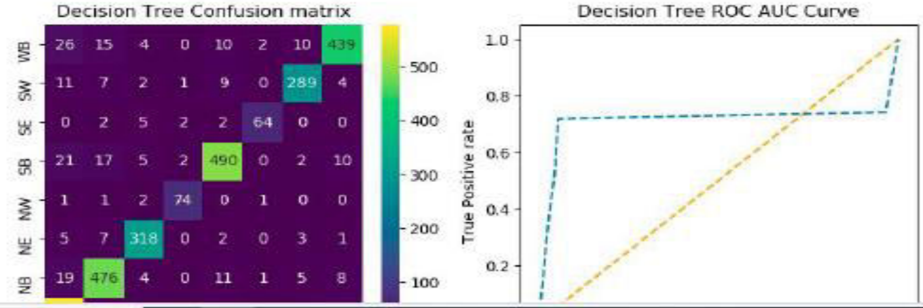
```
SVM Accuracy  : 31.133333333333336
SVM Precision : 31.004129496355183
SVM Recall    : 32.70180924616988
SVM FSCORE    : 30.44985630229018
```



In above screen training SVM algorithm and after training SVM got 30% accuracy and can see other metrics also. In confusion matrix graph x-axis represents Predicted Labels and y-axis represents True Labels and all boxes in diagnol represents correct prediction count and remaining boxes represents incorrect prediction counts and from above graph we can notice SVM predicted many records incorrectly. In ROC curve graph x-axis represents False Prediction and y-axis represents True Predictions and if blue line comes on top of orange line then predictions are correct and if goes below orange line then predictions are incorrect and in above graph we can see only few predictions are correct

```
In [40]: #train machine learning Decision Tree algorithm to predict route with less traffic
         dt_cls = DecisionTreeClassifier()
         dt_cls.fit(X_train, y_train)
         #perform prediction on test data
         predict = dt_cls.predict(X_test)
         #calculate prediction accuracy and other metrics
         calculateMetrics("Decision Tree", y_test, predict)
```

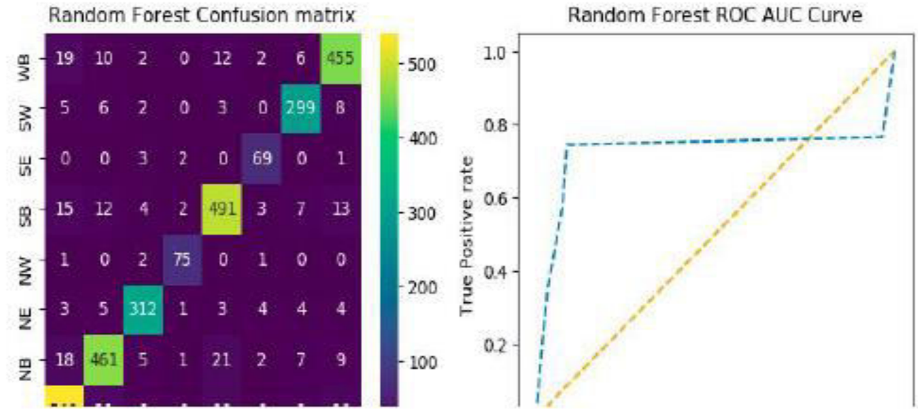
```
Decision Tree Accuracy  : 90.9
Decision Tree Precision : 91.86430129700473
Decision Tree Recall    : 90.61112966428581
Decision Tree FSCORE    : 91.17487186109318
```



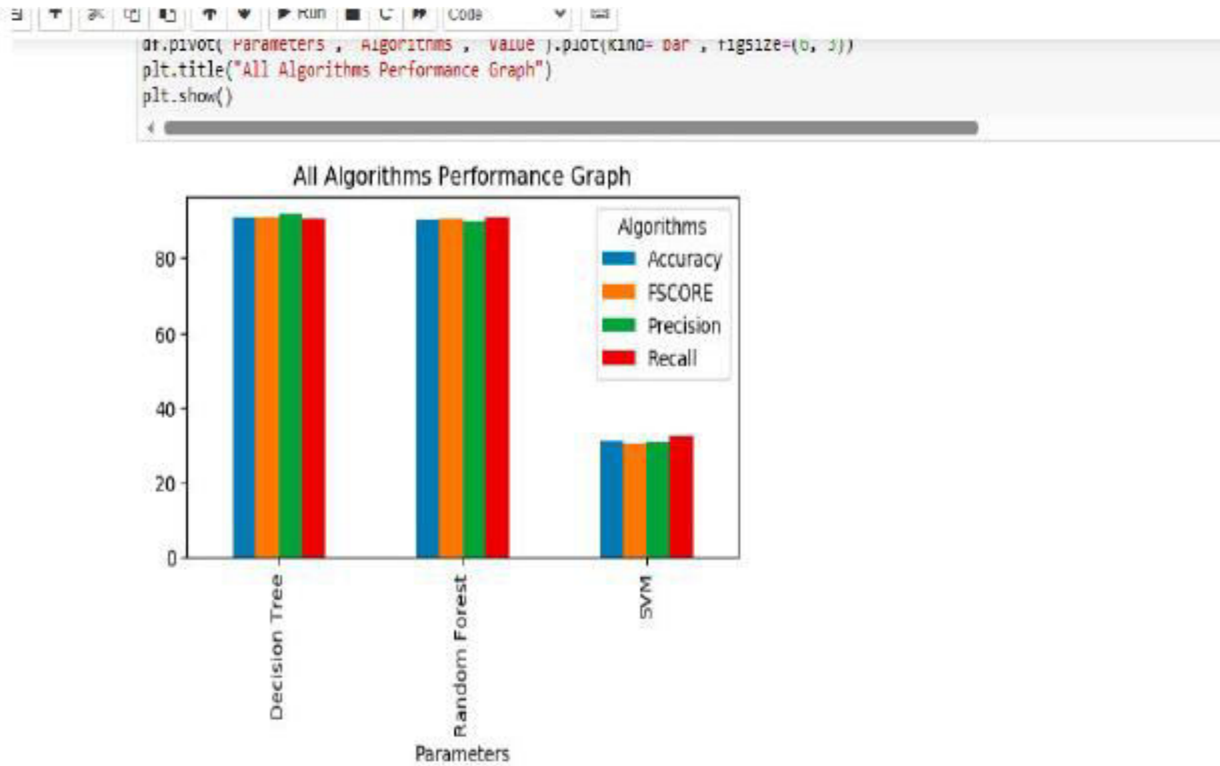
In above sceen training decision tree and it got 90.9% accuracy and can see other metrics and results graph

```
In [41]: #train machine learning Random Forest algorithm to predict route with less traffic
         rf_cls = RandomForestClassifier()
         rf_cls.fit(X_train, y_train)
         #perform prediction on test data
         predict = rf_cls.predict(X_test)
         #calculate prediction accuracy and other metrics
         calculateMetrics("Random Forest", y_test, predict)
```

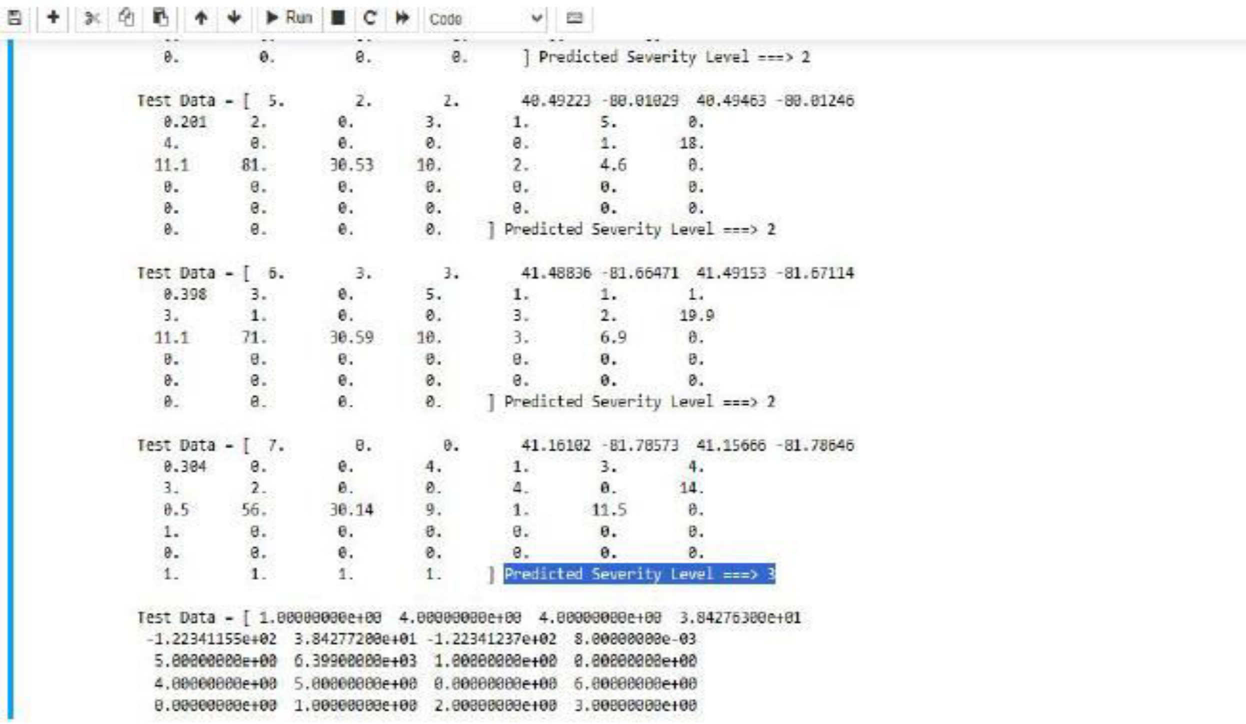
```
Random Forest Accuracy  : 90.06666666666666
Random Forest Precision : 89.96104315033158
Random Forest Recall    : 91.06856115179579
Random Forest FSCORE    : 90.49339312969748
```



In above screen training Random Forest and it got 90.06% accuracy and can see other metrics also and in above confusion matrix graph in diagnol we can see many records are correctly predicted and in all blue boxes only few are incorrectly prediction. In ROC graph also we can see only few predictions are incorrect



In above graph x-axis represents algorithm names and y-axis represents accuracy and other metrics in different color bars and in all algorithms Random Forest and Decision Tree work best



```
 0.         0.         0.         0.        ] Predicted Severity Level ===> 2

Test Data - [  5.         2.         2.         40.49223 -80.01029  40.49463 -80.01246
   0.201      2.         0.         3.         1.         5.         0.
   4.         0.         0.         0.         0.         1.         18.
   11.1       81.        30.53      10.        2.         4.6        0.
   0.         0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.       ] Predicted Severity Level ===> 2

Test Data - [  6.         3.         3.         41.48836 -81.66471  41.49153 -81.67114
   0.398      3.         0.         5.         1.         1.         1.
   3.         1.         0.         0.         3.         2.         19.9
   11.1       71.        30.59      10.        3.         6.9        0.
   0.         0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.       ] Predicted Severity Level ===> 2

Test Data - [  7.         0.         0.         41.16102 -81.78573  41.15666 -81.78646
   0.304      0.         0.         4.         1.         3.         4.
   3.         2.         0.         0.         4.         0.         14.
   0.5        56.        30.14      9.         1.         11.5       0.
   1.         0.         0.         0.         0.         0.         0.
   0.         0.         0.         0.         0.         0.         0.
   1.         1.         1.         1.       ] Predicted Severity Level ===> 3

Test Data - [ 1.00000000e+00  4.00000000e+00  4.00000000e+00  3.84276300e+01
 -1.22341155e+02  3.84277200e+01 -1.22341237e+02  8.00000000e-03
  5.00000000e+00  6.39900000e+03  1.00000000e+00  0.00000000e+00
  4.00000000e+00  5.00000000e+00  0.00000000e+00  6.00000000e+00
  0.00000000e+00  1.00000000e+00  2.00000000e+00  3.00000000e+00
```

In above screen in square bracket we can see accident Test Data and after =□ symbol we can see predicted severity as 2 or 3 or 4

VIII. CONCLUSION

In conclusion, the "Vehicle-to-Vehicle Communication" project represents a pivotal stride towards enhancing the intelligence and efficiency of contemporary transportation systems. By introducing a robust communication framework between vehicles, this project aims to redefine the dynamics of road safety, traffic management, and overall driving experience. The pursuit of a decentralized Vehicle-to-Vehicle (V2V) communication system underscores a commitment to addressing the limitations of existing centralized traffic management systems. The envisioned V2V communication system brings with it a multitude of benefits. Real-time collaboration between vehicles enables swift response to changing road conditions, contributing to improved safety on our roadways. The sharing of critical information, such as traffic updates and collaborative traffic management, forms the foundation for a dynamic and adaptive transportation ecosystem. Moreover, the decentralized nature of the proposed system ensures resilience and scalability. The ability for vehicles to communicate autonomously fosters a selforganizing network that can withstand disruptions and scale seamlessly with the growing number of connected vehicles. This resilience is a fundamental attribute in ensuring the reliability and sustainability of the communication infrastructure. As we move towards an era of intelligent transportation systems, the "Vehicle-to- Vehicle Communication" project is positioned at the forefront of innovation. It not only promises a safer and more efficient driving experience but also sets the stage for the evolution of connected transportation networks. By fostering collaboration between vehicles, this project charts a course towards a future where our roads are not just traversed but navigated intelligently, ensuring a harmonious and secure transportation landscape for generations to come.

IX. FUTURE SCOPE

The future scope of Vehicle-to-Vehicle (V2V) communication projects holds tremendous potential for revolutionizing transportation systems and enhancing road safety. As autonomous vehicle technology continues to advance, V2V communication will play a crucial role in enabling vehicles to cooperate and coordinate their actions on the road. V2V systems will facilitate real-time sharing of sensor data, allowing autonomous vehicles to anticipate and respond to potential hazards more effectively. V2V communication can contribute to reducing the environmental impact of transportation by optimizing vehicle routes, minimizing idling times, and promoting eco-friendly driving behaviors. By facilitating smoother traffic flow and reducing stop-and-go patterns, V2V systems can help lower fuel consumption and emissions.

X. REFERENCES

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