A SENSING COMMUNICATION AND COMPUTING APPROACH FOR VULNERABLE ROAD USERS SAFETY

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Abstract- Most fatal road accidents in urban areas involve vulnerable road users. New solutions for fighting against **these accidents can be considered by leveraging connected, intelligent vehicles and smart cities connecting** all parts of an urban environment. This work proposes a multi-sensing and communication approach to prevent potential accidents between vehicles and VRUs, by predicting and notifying both about potential collisions before they happen. This approach leverages and aggregates information from smart city sensors, dispersed in the vehicles (and aggregated by the On-Board Units, OBUs), in the VRUs (e.g., smartphones and smartwatches), and on the road itself (e.g. video cameras, radars, lidars). These elements communicate through several message standards and wireless access technologies (e.g. ITS-G5, C-V2X, LTE, 5G and, in the future, 6G). Using both sensing and communication, fusion and collision detection algorithms, this system predicts and notifies potential hazardous situations involving Vulnerable Road User (VRU)s and vehicles. The results in a real scenario with sensors, VRUs and vehicles on the road show that the system predicts potential collisions with high accuracy and low delay. Results also point to some vital deployment decisions that must be made to ensure proper notification timings, such as the usage of multihoming, 5G and edge computing.

Keywords: . ITS-G5, C-V2X, LTE, 5G and, in the future, 6G)

I. INTRODUCTION

According to the World Health Organization [1], in 2016 1.35 million people died within road accidents. In an urban environment, roads can be hazardous for Vulnerable Road Users (VRUs), such as children, disabled or impaired people, older people, and other types of pedestrians. In addition, non human VRUs, such as dogs or wild animals, can pose a danger to vehicles and their occupants. With the advent of smart cities, more and more data can be obtained from road users, namely vehicles and VRUs. These data can improve urban environments in entertainment, traffic management, urban planning, health, and, more crucially, road safety. At the core of smart cities are road elements connected with a shared infrastructure. A smart city can contain several Intelligent Transportation Systems (ITSs) vehicles (with capabilities for sensing the surrounding environment)and VRUs with smart phones and other connected wearable devices, but also other road infrastructure sensors (such as video cameras, Radio Detection And Ranging (Radar), Light Detection And Ranging (Lidar) and other sensors) to create a complete picture of the current status of the smart city. References [2], [3], [4]. The amount of information a smart city can send to vehicles and the vehicle's sensing capabilities is now sufficient to support semi-autonomous vehicles. Vehicles now possess the information to support helping and replacing the driver in several tasks such as park assist, lane merging assist, and keeping a stable distance from another car (adaptive cruise control). These capabilities support the end goal of manufacturers to achieve full autonomy within their vehicles [5], [6], while ensuring the safety of passengers and others VRUs outside the vehicle. Current solutions to ensure VRU safety focus on the vehicle being able to act and react to its surroundings - and for example, break if a VRU is close - based on the information from the vehicle onboard sensors [7]. However, these solutions require the vehicle to be fully equipped with sensors, not equipped in older or cheaper vehicles. Moreover, they do not fully explore the full potential of smart city infrastructures and available data. Road elements, sensors and infrastructure within smart cities can, in cooperation with intelligent vehicles, provide information about the status of vehicles and VRUs, for one side, and warn them in real time about currently dangerous situations. In addition, smart cities could also power new services to predict dangerous situations before they happen, significantly reducing the risk for vehicles and VRUs.

II. RELATED WORK

Title: A Sensing, Communication, and Computing Approach for Vulnerable Road Users Safety: A Literature Review

Introduction:
The safety of vulnerable road users, including pedestrians, cyclists, and motorcyclists, remains a critical concern in urban transportation systems. With the advancement of sensing, communication, and computing technologies, there is growing interest in leveraging these technologies to enhance the safety of vulnerable road users. This literature review aims to provide an overview of recent research and developments in this area, focusing on the use of sensing, communication, and computing approaches to improve the safety of vulnerable road users.

1. Sensing Technologies:

- Various sensing technologies, such as cameras, LiDAR (Light Detection and Ranging), radar, and ultrasonic sensors, have been explored for detecting and tracking vulnerable road users in traffic environments.
- Research has focused on developing algorithms and techniques for real-time detection, recognition, and classification of pedestrians, cyclists, and motorcyclists based on sensor data.
- Integration of sensor data fusion techniques to improve the accuracy and reliability of detection and tracking systems, especially in challenging environmental conditions and complex traffic scenarios.

2. Communication Technologies:

- Wireless communication technologies, including Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communication, enable the exchange of information between vehicles, infrastructure, and vulnerable road users.
- Research has investigated the use of communication protocols and networking architectures to support safety applications such as collision avoidance, intersection assistance, and pedestrian warning systems.
- Challenges include addressing latency, reliability, and security issues in communication networks to ensure timely and robust delivery of safety-critical information.

3. Computing Approaches:

Computational methods such as machine learning, computer vision, and artificial intelligence have been applied to analyze sensor data and make informed decisions for improving vulnerable road users' safety.

Research focuses on developing predictive models, risk assessment algorithms, and decision-making frameworks to anticipate and mitigate potential hazards and conflicts in traffic interactions.

Integration of computing approaches with sensing and communication technologies to enable intelligent safety systems that adapt to dynamic traffic conditions and user behaviors.Recent advancements in sensing, communication, and computing technologies offer promising opportunities to enhance the safety of vulnerable road users in urban transportation systems. However, challenges remain in integrating these technologies effectively, addressing reliability and security concerns, and ensuring user acceptance and adoption. Future research directions may involve interdisciplinary collaborations, field evaluations, and pilot deployments to validate the effectiveness and feasibility of sensing, communication, and computing approaches for vulnerable road users' safety.

III. METHODOLOGY

Admin

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as View All Users and Authorize, View All Dataset Details, View All VRU Dataset Details By Clusters, View All Dataset Details By Clustering, View Vulnerable Road Users Safety Status Results, View Area Results.

User

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user’s details such as, user name, email, address and admin authorizes the users.

User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like Register and Login, View Profile, Upload Datasets, View All Uploaded Datasets, Find Vulnerable Road Users Safety Status, Find VRU Type Results By Hash code.

IV. PROPOSE SYSTEM & IMPLEMENTATION

In this work, we explore and implement a system that focuses on improving the safety of VRUs within a smart city environment by using a multi-sensor system and communication to predict and warn about potential collisions. The proposed system provides an overview of the system behavior. The system receives as input existing information from intelligent vehicles (1) and the smart cities (2), and implements a solution to obtain the status of the VRUs from their smartphones (3). The system then fuses and processes the information to decide if a collision is likely and, if so, it warns vehicles and VRUs. To communicate with vehicles and VRUs, the system leverages multiple access communication technologies (IEEE 802.11pWAVE (WAVE), Long Term Evolution (LTE), 5G) and edge computing. The proposal of this article is to improve VRU Safety in an active way, using sensor detection in the vehicles, in the VRUs and in the roads and communication between themselves, to predict, warn and prevent potential accidents between vehicles and VRUs. For this approach, it proposes a multi-sensor solution that leverages existing information sources, such as radars, video cameras, messages communication from vehicles and from VRUs smartphones. With this information, gathered through communication technologies such as ITS-G5, 4G and 5G, it proposes a prediction algorithm, in the cloud and in the edge, that assesses collision probability based on kinematics. The results in a real road scenario show that the system can react with low times compatible with ITS services, and that 5G communication and the edge processing can provide great advantages. The results also show how the accuracy of the system can improve with the different

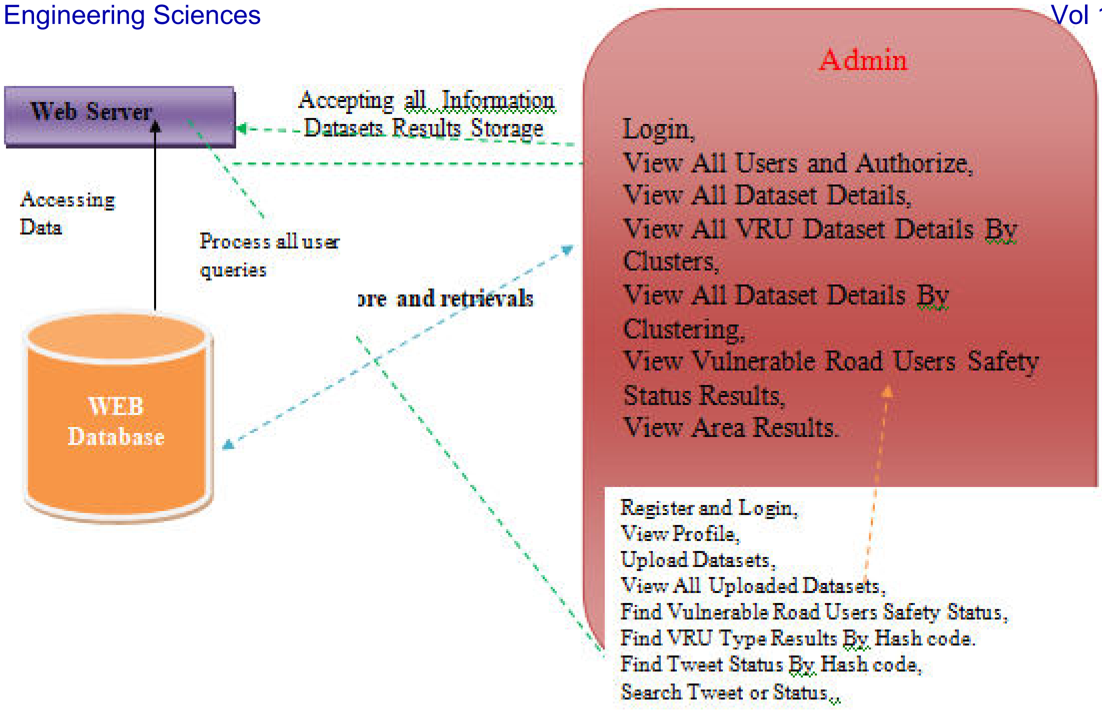

Figure 1: Proposed system architecture

V RESULT ANALYSIS

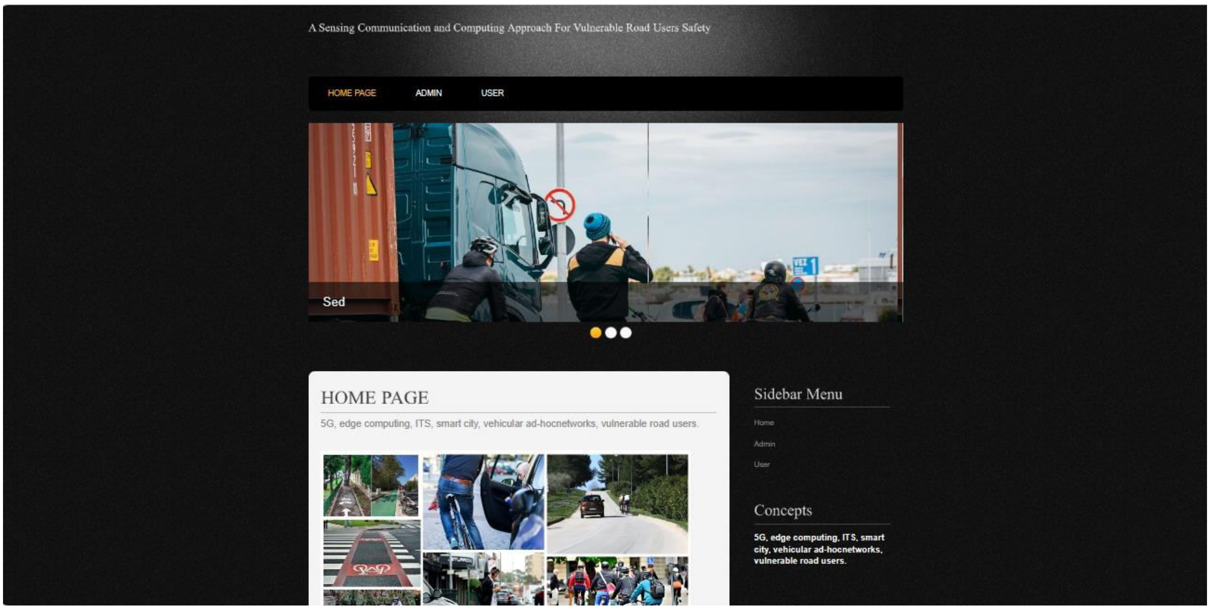

Fig 2. Home Page

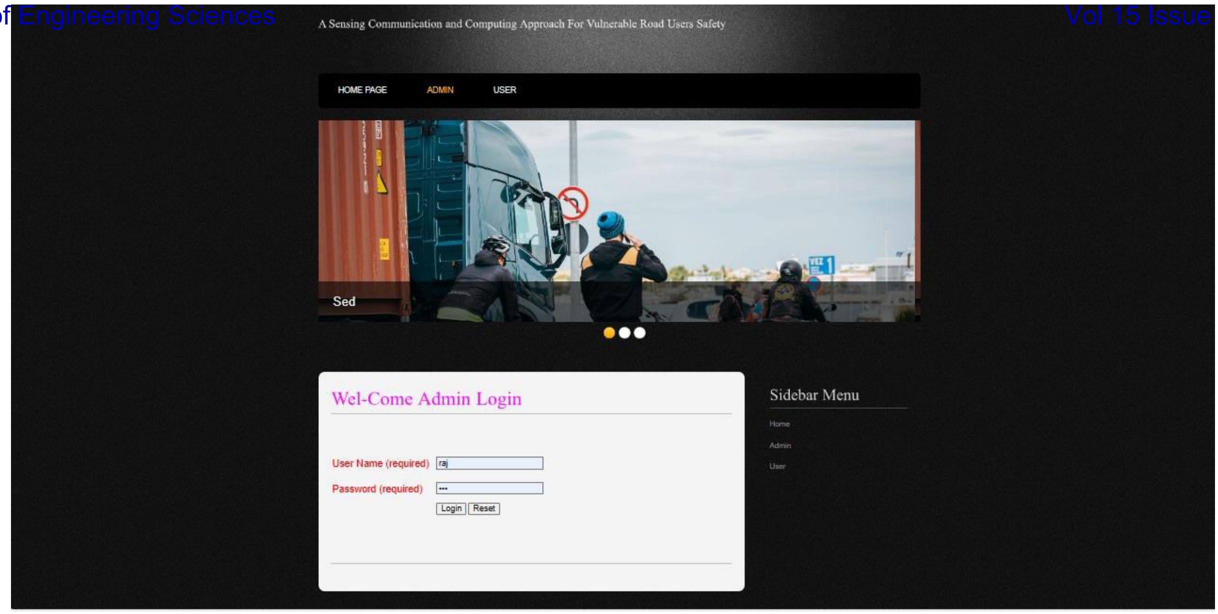

Fig 3:- Admin login page

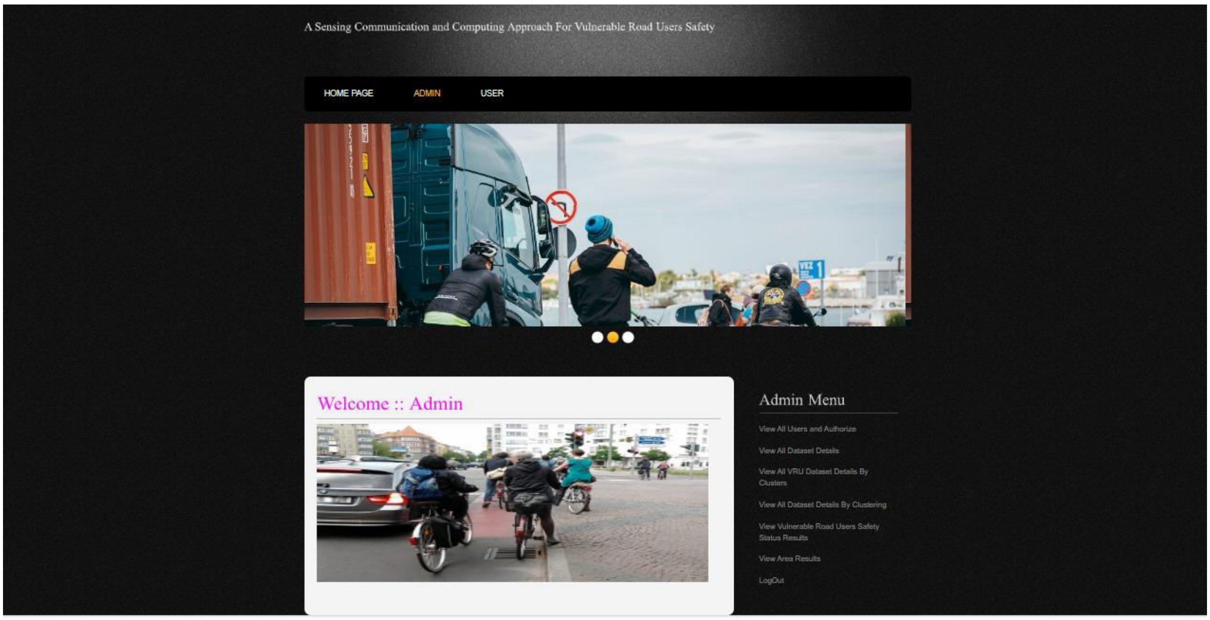

Fig 4:-.Admin Home Page

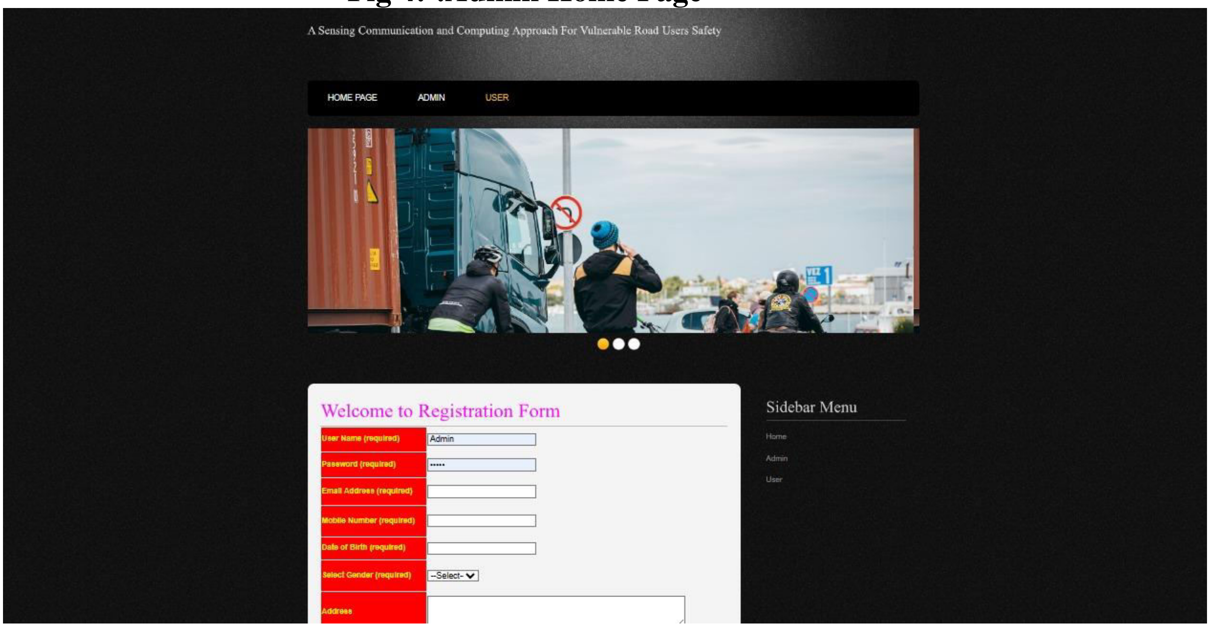

Fig 5 :- User Registration page

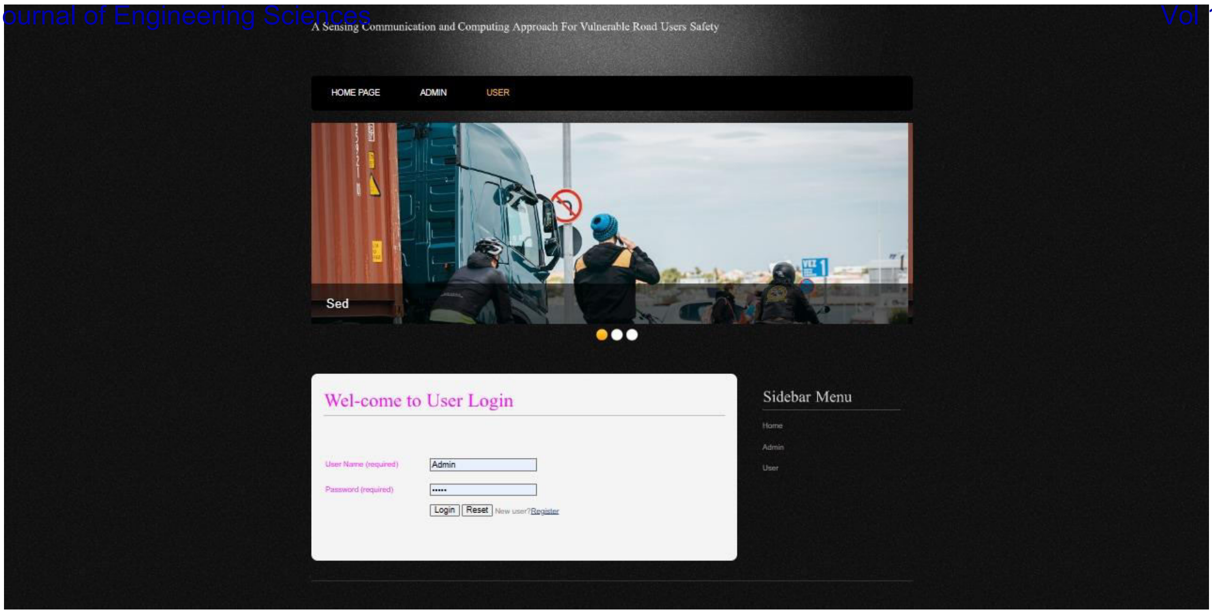

Fig 6:-. User Login Page

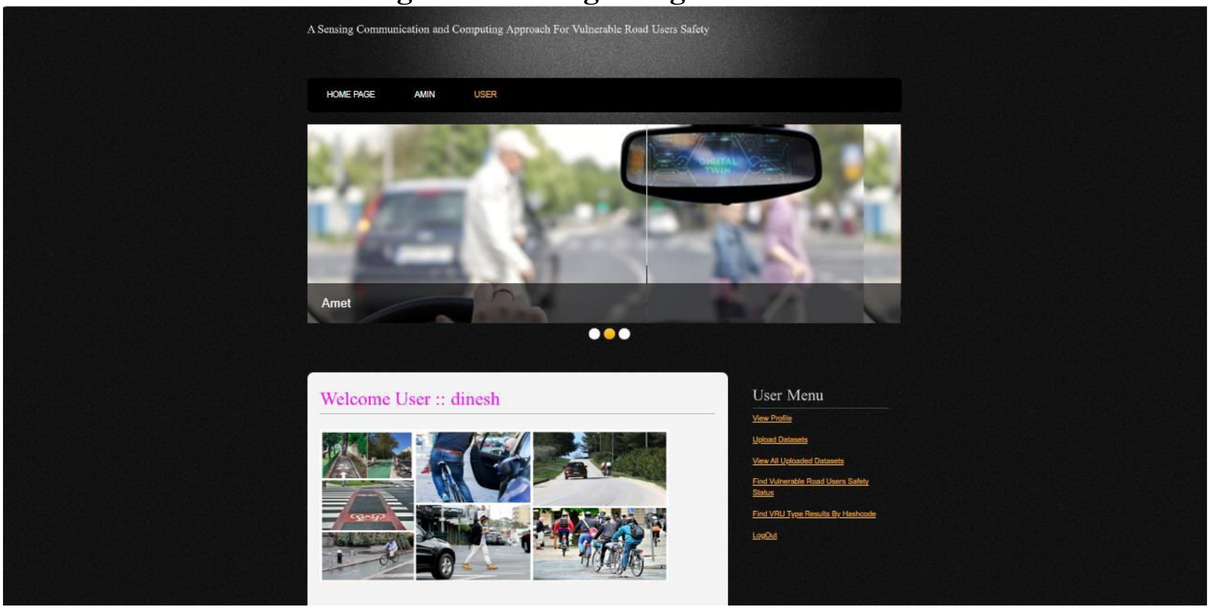

Fig 7:-User Home page

VI CONCLUSION

This article proposed an approach with sensing, communication and processing capabilities to predict potentially dangerous situations - such as collisions - between vehicles and VRUs. This solution is crucial, considering the current number of fatal crashes involving VRUs. The amount of previous work exploring potential solutions to mitigate these exact problems corroborates that.

The proposed solution distinguishes itself from others by the fact that: (1) it uses aggregated data fusion from real sensors, such as video cameras, radars and data from communication vehicular and VRU messages; (2) it extends vehicular and VRU messages to integrate the required sensing data; (3) it proposes an algorithm for data fusion and collision prediction;(4) it studies both edge and cloud-based approaches; and (5) it uses both ITS-G5, 4G and 5G technologies.

This approach has been tested in a real environment with real infrastructure and aggregated and processed real data from the Aveiro Tech City Living Lab. The results showed that the system could detect dangerous situations with small latencies, high accuracy and scalability. The comparison of edge and cloud solutions, as well as 4G and 5G technologies, has also been provided, showcasing both the need for hybrid (cloud and edge) architectures and the need for next-generation network technologies.

Future work includes the improvement of the accuracy by supporting more sensors and an extension of the system to consider characteristics and use cases of other types of VRU (e.g. bicycles and motorcycles).

VII REFERENCES

[1] W. H. O. Social Determinants of Health Team, "Global Status Report on Road Safety 2018: Summary," World Health Organization, Tech. Rep. 1, 2018. [Online]. Available: https://www.who.int/publications/i/ item/9789241565684

[2] Z. Lv, L. Qiao, Q. Wang, and A. K. Singh, "AI-empowered IoT Security for Smart Cities," ACM Transactions on Internet Technology, vol. 21, no. 4, p. 99, 2021. [Online]. Available: https://doi.org/10.1145/3406115

[3] M. Batty, K. W. Axhausen, F. Giannotti, A. Pozdnoukhov, A. Bazzani, M. Wachowicz, G. Ouzounis, and Y. Portugali, "Smart cities of the future," Eur. Phys. J. Special Topics, vol. 214, pp. 481–518, 2012.

[4] A. Caragliu, C. Del Bo, and P. Nijkamp, "Smart Cities in Europe," Journal of Urban Technology, vol. 18, no. 2, pp. 65–82, 2011. [Online]. Available: https://www.tandfonline.com/action/ journalInformation?journalCode=cjut20

[5] K. Darlington, "Fully Autonomous Cars. Will They Become a Reality?" [Online]. Available: https://www.bbvaopenmind.com/en/technology/ innovation/fully-autonomous-cars-how-and-when-will-become-reality/