Smart Accident Response System (SARS)

FORUM8 12th CPWC

The Guardians

Overview

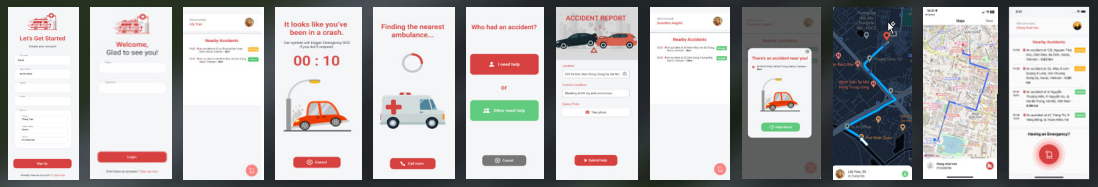
In recent years, the number of traffic accidents increases significantly. The Smart Accident Response System (SARS) is an innovative solution designed to enhance the road safety and the efficiency through the real-time accident detection, immediate response coordination, and advanced analytics. Leveraging the power of digital twins and the metaverse, the SARS integrates the cutting-edge technologies that provides a comprehensive traffic accident quick response support system. By harnessing these technologies, the SARS not only improves immediate accident response, but It also contributes for the long-term goals of safer and more efficient roadways support system.

A. Real-Time Accident Detection: SARS utilizes Accelerometer, Gyroscope sensors, Microphones, AI Algorithms to detect the accidents more instantly. This provides immediate alerts to the emergency services and the traffic management centers.

B. Digital Twin Integration: Creates a real-time digital replica of road networks to monitor and to simulate the traffic conditions. Facilitates detailed analysis of accident scenarios to improve the response of the emergency services. Also, can simulate scenarios of the traffic accidents for machine learning study purpose and for testing the systems to apply more efficiently in the real-world scenarios.

C. Metaverse for Training and Coordination: The app offers more immersive virtual reality world environments for the training in preparing the first emergency responders. Enables the virtual command centers for more efficient coordination among all the smart traffic lights and the nearby emergency service centers.

Development Flow



Phase 1 (Ideate): Firstly, the driver activates the app, which continuously monitors for accidents. Upon detecting an accident, the app assesses its severity. If there is an accident, the SARS app sends warnings to drivers within 3 km from the accident site and alerts the nearest ambulances, based on calculated distances and real-time traffic conditions. The available ambulance driver confirms whether he or she can help the victim, and the app sends that driver the shortest route. The system checks if ambulance is approaching. So, traffic lights adjusted to prioritize the ambulance's route. Once the ambulance reaches the accident area, it confirms arrival and the app then determines best route to the nearest hospital, ensuring prompt and efficient emergency response. If accident is not severe, or it is not an accident, the user can confirm that no ambulance needed. The idea of detecting an accident depends on 3 key actors: Accelerometer and Gyroscope, Microphone, Machine Learning and Data Analysis.

1. Accelerometer & Gyroscope: By analyzing data from sensors, app can detect unusual patterns typical of car accidents, such as the rapid deceleration followed by sudden stop or violent jolt while driving on the roadways.
2. Microphone: The app can use the device's microphone to listen for clear loud and sudden and to distinguish the normal ambient noise with the sounds that more are indicative of any types of traffic accidents on the road.
3. Machine Learning and Data Analysis: Trained on vast amounts of data to recognize patterns associated with accidents. These models can analyze sensor data in real-time to detect potential accidents with high accuracy.

The idea for the smart traffic lights bases on the 3 main actors: Routing, Computer Vision and GPS tracker sensors.

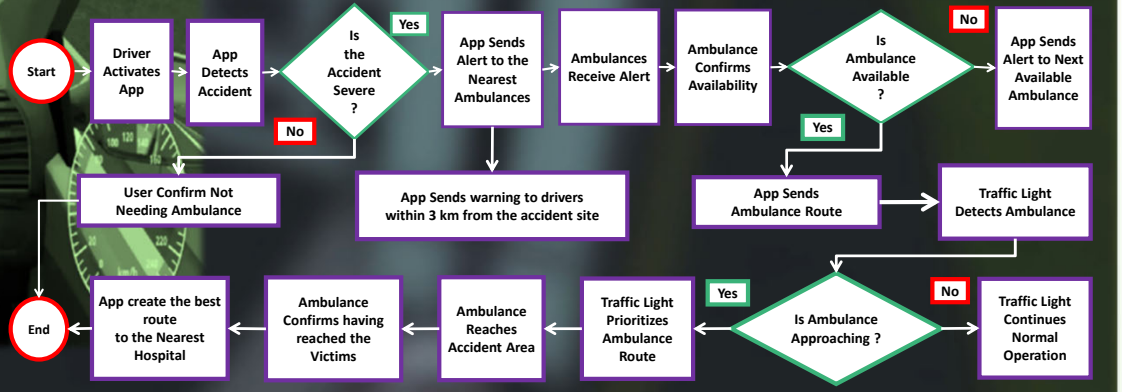
1. Routing: The application will send the information of the ambulance's path. Based on the information and the GPS tracker, the smart traffic lights will be adjusted to prioritize the ambulance's route over the current traffic.
2. Computer Vision: We use computer vision to detect ambulances and captures traffic live feed of other vehicles
3. GPS Tracker: This sensor is responsible for tracking the location of ambulances and help the prioritized routes become more accurate (In case ambulances do not follow the predefined route) route to the nearest hospital.

System Design

Phase 2 (System Design): We have used the FigJam whiteboard to design system flow and Figma tool to design the App UI/UX

Phase 3 (Developing Application): We used various frameworks and some libraries to develop our application: For, the Front-end: React Native, Expo, Redux, Redux Saga, Typescript, Map. In Back-end: NodeJs, Express, bcrypt, Mongoose (ODM) library, Docker platform container. Using Database MongoDB and also using some other Plug-in like in the UC-win/Road, and the UC-win/Road SDK etc.

Phase 4 (Prototyping and Testing): After developing and packaging application, we start testing the app. Then, using UC-win/Road to build the city with roads to stimulate real accident scenes. Finally, we have record and edit the process into a demo video for presentation.



mongoDB. FORUM 8 Virtual reality design studio UC-win/Road React Native node.js

Future tasks and ideas

1. Model Optimization and Accuracy Improvement: To continuously improve the machine learning model by incorporating more advanced algorithms like deep learning to handle more complex scenarios and to reduce false positives/negatives. Collect more diverse and extensive datasets, including the data from different environments, many types of road accidents, and various user behaviors, to enhance the model's robustness.
2. Digital-World Testing and Feedback: FORUM8 latest facilities and applications to implement the stimulated system in controlled virtual environments and conduct digital-world testing with volunteers to gather feedback and fine-tune the current model. Develop a mechanism for users to provide more detail feedback on the system's accuracy, therefore enabling furthermore iterative improvements on the accident response system.
3. Integration with IoT and Smart Devices: using smart devices expand the module's application by integrating it with IoT devices such as smartwatches, smartphones, and vehicle systems to broaden its reach and utility. Also, enhancing the cross-device communication to enable communication between multiple devices (e.g., phone and various vehicle car systems) to create a more comprehensive road accident detection network systems.
4. Scalability and Deployment: Use of cloud integration to develop cloud-based solutions for the data processing and storage to handle large-scale deployment and provide further seamless updates to the model. Along with other customization options to provide options for users to customize alert thresholds and responses based on their preferences and needs can be use. Also implementing the global deployment to plan for scaling the system to different regions and markets, considering the local regulations and other environmental factors.
5. Regulatory Compliance and Partnerships: use of compliance to ensure the module complies with relevant safety and data privacy regulations, especially in the healthcare and automotive sectors. Additionally join in partnerships to collaborate with the industry partners, such as the automobile manufacturers, insurance companies, and emergency services, to enhance the system's value and more integration and improvements.