VEHICLE-TO-INFRASTRUCTURE CONTEXTUAL EMERGENCY EVENT CLASSIFICATION, SCORING, AND RESPONSE

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VEHICLE-TO-INFRASTRUCTURE CONTEXTUAL EMERGENCY EVENT CLASSIFICATION, SCORING, AND RESPONSE

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ABSTRACT

Techniques are described herein for precisely determining conditions of accident patients, including assessing severity, determining a best trauma center, and deciding the best route to take to the trauma center. Vehicle-to-Infrastructure (V2I) contextual emergency event classification, scoring, and response may be achieved by obtaining speech or video input provided by an Emergency Medical Services (EMS) operator and running the input through a Recurrent Neural Network (RNN) (for speech input) and/or a Convolutional Neural Network (CNN) (for video input) to convert the input into keywords. The keywords can be run through a Multilayer Perceptron (MLP) to identify certain medical-specific keywords to determine a category of doctor and a severity (e.g., Level 1 to Level 6, where Level 6 refers to least severe and Level 1 refers to most severe). The category of doctor and severity are then input into a hospital determination algorithm along with time and location data. Once the appropriate hospital is determined, that data is fed into a hospital routing algorithm to route the ambulance to the hospital. Unlike standard Global Positioning System (GPS), this routing procedure also uses road design data, which includes additional information regarding road conditions (e.g., whether the road has speed bumps, whether the road has a physical divider, etc.).

DETAILED DESCRIPTION

Delays in first responder transportation caused 14.1% of fatalities in cities and suburbs between 2013 and 2015 due to slower-than-average Emergency Medical Services (EMS) response times. In addition, Emergency Departments (EDs) are overcrowded in many cases, requiring the patient to be rerouted to another care center. This impacts morbidity, mortality, patient satisfaction, and cost, and is often caused by a lack of specialty services (e.g., trauma, neurosurgery, Percutaneous Coronary Intervention (PCI), etc.) and
a lack of specialty tools (e.g., Intensive Care Unit (ICU) beds, Computed Tomography (CT) scanners, isolation rooms, etc.), or simply due to patient preference.

Electronic routing systems in ambulances that identify the best routes to take may improve response time. The particular hospital to which trauma victims are taken also impacts survival rates. For example, a Level 1 trauma center will improve outcomes for the severely injured.

These issues may be addressed with a system for precisely determining a specific medical facility to which to route patients. A mechanism to provide a path to that facility may further improve patient prospects. Accordingly, described herein is an approach for Vehicle-to-Infrastructure (V2I) contextual emergency event classification, scoring, and response.

The solution collects audio and video data from a first responder's point of view, which provides information during the incident. Once collected, this data is run through a scoring algorithm which assigns a level of severity to the incident (e.g., Level 1 to Level 6, where Level 6 refers to "least severe" and level 1 refers to "most severe") in order to initially determine the patient's priority prior to arriving to an appropriate medical facility. Based on the input obtained through natural language processing or viewed via image/video processing, the patient can be routed to a specific medical facility that has a specialist on hand along with specific tools that are crucial for treating the patient.

Algorithms initially determine the profile of the incident through speech recognition and natural language processing of audio along with video processing of open injuries using a mixed set of neural networks. The neural networks may include a Recurrent Neural Network (RNN) for speech recognition, a Multilayer Perceptron (MLP) for natural language processing, and/or a Convolutional Neural Network (CNN) for image/video processing.

Figure 1 below illustrates an example block diagram outlining the design of the algorithm.
Upon determining the appropriate medical center, the ambulance may be routed thereto. The response mechanism may include a typical Global Positioning System (GPS) - based routing system with additional information regarding the design of the various roads available. This can include information regarding speed bump occurrence, which is helpful because speed bumps can worsen the condition of onboard patients and/or slow delivery of the patient, whether the road type is divided or undivided, etc. The data can be mapped out using traditional methods (e.g., traffic reports, traffic cameras, pre-scheduled construction event submissions, etc.) or crowd-sourced. The "Road Design Data" block in Figure 1 refers to this data and also includes construction, traffic, events such as political rallies and sporting events, etc.

Figure 2 below illustrates an example divided road type.
Figure 3 below illustrates an example undivided road type. As shown, the center lane is marked for left-hand turns.

In addition, for roads with designs such as bridges or tunnels, unclogging the road becomes paramount to quick response. Ambulances may take these roads a last resort. This can be accomplished through V2I communication to smart road signs, level crossings, bridges, etc. in order to facilitate proper traffic flow for all traffic within the path of the ambulance.

Figure 4 below illustrates an example overhead view of a tunnel with no emergency road access.
In summary, techniques are described herein for precisely determining conditions of accident patients, including assessing severity, determining a best trauma center, and deciding the best route to take to the trauma center. V2I contextual emergency event classification, scoring, and response may be achieved by obtaining speech or video input provided by an EMS operator and running the input through a RNN (for speech input) and/or a CNN (for video input) to convert the input into keywords. The keywords can be run through a MLP to identify certain medical-specific keywords to determine a category of doctor and a severity (e.g., Level 1 to Level 6, where Level 6 refers to least severe and Level 1 refers to most severe). The category of doctor and severity are then input into a hospital determination algorithm along with time and location data. Once the appropriate
hospital is determined, that data is fed into a hospital routing algorithm to route the ambulance to the hospital. Unlike the standard GPS, this routing also uses road design data, which includes additional information regarding road conditions (e.g., whether the road has speed bumps, whether the road has a physical divider, etc.).