Traffic Generation and Animation for Road Information System

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Abstract

This paper presents an algorithm for visualizing the traffic condition. The load of each road is updated using the incoming data collected by the devices placed at specific road crossings and junctions. The data includes the road occupancy, average speed, and vehicle types. They are analyzed to produce the 3D animation sequence of the traffic in real-time. This visualization maximizes the value of the collected data by aiding the end-users to grasp the current road situation intuitively. The traffic of a particular lane are based on the actual number of vehicles of that type passed during the last 5 minutes. This system was used in the Ministry of Construction and Public Transportation to visualize the Korean roads during the holidays around the lunar new year of 1997.

1 Introduction

While simulations are used to produce a bunch of numbers which need to be interpreted by the user in the old days, recent visual simulations provide more direct way of interpreting and managing data. Therefore the computer generation of believable behavior from particular data are emerging as an important technique in many VR applications[1].

This paper presents the general algorithm for visualizing traffic conditions in 3D by an animated sequence. Generally the traditional method of this kind of road visualization scheme relied on cameras located at specific lanes. The side-effects of this approach is quite obvious. Users gain only a static view of the environment. Also the mechanical nature of the instrument is responsible for rapid deterioration of the equipment and huge maintaintance costs, which hinders it from prolonged use.

Our approach to this problem is inherently different from previous one. Data which possess informations about the occupancy of the road, average speed and vehicle types, are gathered by sensors located at specific intervals along the roads. Our implementation achieved real time 3D animation from these data. The raw information collected by aforementioned process is relatively small and generally esoteric to the public, but we were able to maximize its value by converting it to a more user-friendly, intuitive format. With this the end-user can gain more control and flexibility over processing data.

The use of the 3D modelling significantly increased the realism of the environment. When converted to low resolution of TV, it wasn't in general possible to distinguish it from the real sceneary. The position manipulators which are essential to 3D modeling tool are also preserved in this animation, thereby allowing users to dynamically change the vieweing angle, position in real time without any perceptible decrease in speed of the animation.

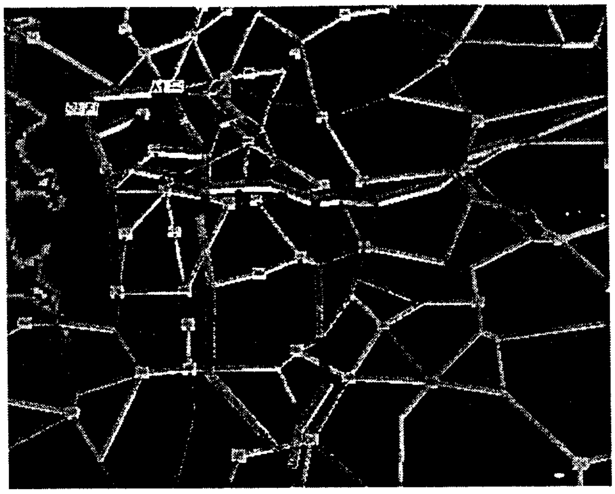

Figure 1: Visualization of road traffic conditions based on the data collected from AVC

2 Automatic Vehicle Classification

Our 3D visualization depends on the data collected by devices placed at specific road intervals. At present we use Automatic Vehicle Classification system developed in France. Although this system is not yet ubiquitiously implemented in Korean roads, it is to be the likely choice in the near future. We will present some general information pertaining to these equipments.

Automatic Vehicle Classification(AVC) was introduced by ECM of France to collect information pertaining to vehicles on highways. AVC instruments consist of two loop sensors and one piezo sensor. Similar system, called Weigh In Motion(WIM) was developed by the same company with an additional functionality of measuring the weight of a running vehicle, but at the expense of two piezo sensors. Piezo sensors are much more expensive than the loop sensors which makes AVC system more affordable choice.

AVC systems are placed on the sideroads with each sensors placed on the roads. Sensors collect the data related to incoming vehicles, while the AVC systems give statistical analysis of the information gathered. AVC distinguishes 11 car types based on the information of vehicles' length, number of axles, distance between axles and overhang. With a response to data requests made from Traffic Information Control Center, informations amassed by the instruments are sent via modem. The AVC system plays an essential role in making an efficient and integrated traffic condition system.

In South Korea, about 130 AVC systems are currently placed on national road. Korean highways are equipped with a similar system from Hyundai Electric Corporation, but due to their simple functionality and low reliability, extensive discussion is going on to replace it with AVC system.

3 Algorithm

To implement the animation we need to efficiently manipulate the given data structures. The data contained in these structures are successively used to generate each frames. These data include the road condition, average speed, number of lanes and the occupancy of specific vehicles.

With a lane, a list is allotted. This list contains the data of vehicles in a linked list fashion. The squence of vehicles shown in the animation corresponds exactly to the squence of vehicle data in the list. This kind of ordering becomes advantageous when calculation of safety distance or speed difference is neccessary. Because only the vehicle in front of the list is compared, efficiency of algorithm is increased.

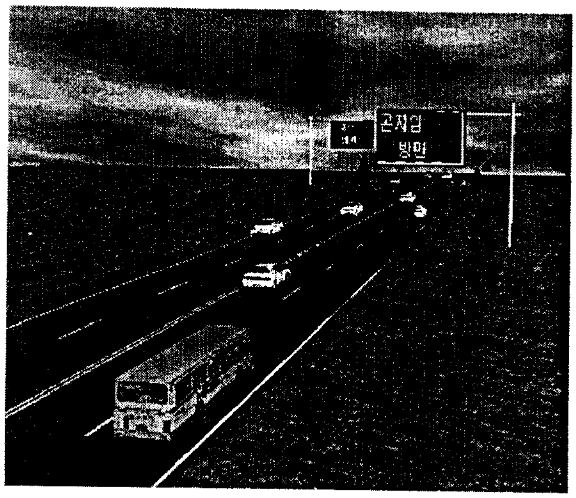

Figure 2: A Snapshot from the traffic load animation

The vehicles in the list acquire speed from the external traffic data with a deliberately added random variations. This speed becomes the maximum speed of an each vehicle. The trailing vehicle is always assigned greater speed than the leading vehicle, but should the safety distance become less than desired, trailing vehicle slows down in order to avoid direct collision while maintaining realistic movement. With a predetermined speed, each vehicle is continuously scaled according to its respective speed, giving the total effect of smooth animation sequences.

This procedure is continued until the foremost vehicle disappears from the horizon and also from the viewer. If this happens the vehicle is removed from the list as to avoid the overhead of drawing too many cars on the screen at once. If the calculated vehicles by the occupancy of the road are less than the number of present vehicles, a new vehicle is introduced randomly between the last vehicle on the list while maintaining the safety distances between them. The lane with a higher occupancy rate has a greater probability of generating new vehicles.

The road maintains its required occupancy by above process of construction and destruction of vehicles. The types of cars are handled probabilisticaly by the occupancy rate of the car types. This car type information points to the modeled entity of specific vehicle. When the actual rasterization takes place this entity is drawn.

4 Performance

We implemented the above algorithm in Visual C++ and OpenGL. The program runs on Pentium 133 PC with a Glyde graphics board. Our program was actually used by Ministry of Construction and Public Transportation during the lunar new year holidays of 1997. Responses were very positive and our visualization method offered more vivid screen images with an interactive view than the previously used blurry cameras.

5 Conclusion and Future Work

In this paper, we presented an effective way to visualize the information collected from the AVC system. The most novel concept in this work is the indirect processing of the raw data. The gathered data can be intrepreted and implemented in different ways by the intention of end-users. This kind of approach does not only give end-users flexiblity but can save huge amount of hardware resources that were previously required. In our work we were able to extend the intrepretation of data by making the them aquire animation format.

Future works include visualization of junctions and curved intersections which are necessary if we are to emulate the road situations more realistically. But these can be only regarded as minor enhancements over the original implementation. More advanced improvements are possible by incorporating ambient car generation [3] with car animation, so that the movement of vehicles could be perceived as more realistic [2].

Acknowledgments

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