Chapter-3

Ideas and Solutions for Avoiding Accidents and Collisions

3.1 Design Idea of a Warning System Suitable for Installation at This Location

As it was emphasized earlier, the purpose of this study is developing a system that can forewarn and prevent possible head-on collisions around the vertical curve located on Rt.114. Along with an ITS based warning system, there are other options that could provide a solution for head-on collisions on this vertical curve. Most obvious solution would be expanding the road (adding more lanes in each direction) around potentially dangerous vertical and horizontal curves. Another solution could be the installation of permanent barriers between two lanes, thus eliminating the possibility of the lane change.

Almost all of the options involving a conventional solution, like the road expansion, have built-in disadvantages that will effect their implementations, negatively. The first and most prominent disadvantage is the fact that solutions requiring a change in existing local geometry and land use will face the opposition from the local landowners. In this particular location on Rt. 114, properties owned by the residents have frontage to this road, and moreover, most of the houses are already very close to the existing highway. An expansion would eliminate the extent of the most driveways, thus making impossible for the residents to park their cars, and get in and out of their property.

For the same basic reason (property owners' access to both directions), it is impossible to separate the existing two-lane highway with a thin barrier, in order to eliminate the lane crossing. Such a solution would also have negative impact on safety related issues (ambulance, fire department, and law enforcement access).

Based on the reasons outlined above, a feasible approach in warning and preventing potential accidents at this location would encompass using a technology-intense application in which the geometry and land use change options would not be needed. Such technology-intense solution would yield a final scenario where a visual warning system, interacting with the traffic conditions and the drivers, would be the mediator, and there would be a minimal change in existing operation of the road.

3.2 The Use of ITS Technology

Today, we are able to utilize many technology-intense instruments and systems in the transportation engineering. The Intelligent Transportation Systems applications vary from traffic monitoring to data gathering, to accident prevention.

Collision warning and avoidance systems are developed with extensive use of available sensor technologies, along with computing devices, which control the functions of systems, and determine the type of countermeasures. Majority of the collision avoidance systems resembles the neural networks, which basically work on the algorithms of action-reaction principles. Different sensor technologies and collision warning & avoidance

systems (CWA) are discussed in details in Appendix B. The whole idea of collision warning and avoidance systems is relatively new, and most of the applications are in their infancy era. No single system is accepted as industry standard, and further developments are needed, in order to standardize the applications.

Most of today's CWA systems are vehicle-born, and either warns the vehicle's driver, or intervene with the vehicle's throttle and/or braking systems. Applicable roadside CWA systems are very limited. The only operational system is in use in Japan. This system warns the drivers approaching horizontal curves in two-lane roads, so that none of the drivers would attempt to change the lane, or try to overtake. The system consist of ultrasonic sensors and warning signal deployed around the horizontal curves, and triggered by the approaching vehicles at either end. Except this system, which has very limited functions, there is no other active CWA system available.

3.3 System Description and Algorithm

As it is examined in detail in Appendix B, the most suitable sensor for vertical curve collision avoidance and warning application is the video image processor (camera) system which is able to detect entire length of the danger zone described on page 14 and Figure-I.6. This video image processor system can be described as the eye of a neural network, which interacts with the on-site computer system, and consequently triggers the warning signals to be sent to the drivers on each direction.

Video image processor can detect speed, occupancy, count, and presence of the vehicles. Because the VIP produces an image of several lanes, there is potential for VIP to provide a wealth of traffic information such as vehicle identification and incident detection. A video image processor generally operates in the following manner: the operator selects several vehicle detection zones within the field of view of the camera. Image processing algorithms are then applied in real time to these zones, in order to extract desired information such as the location or the speed of the vehicle. Once this information is gathered, on-site computer determines the required measure and activates the connected warning devices.

The development of the warning system algorithm of this research project is based on the danger and visibility zones established previously. The scanning and warning algorithm for the vertical curve on Rt.114 is described in Figure-I.8. Sensor tower site and scanning areas are illustrated in Figure-I.9.