CHAPTER 6. SYSTEM ARCHITECTURE

6.1 Introduction

The system architecture is the framework that describes how the system components interact and work together to achieve the overall system goals. It describes the system operation, what each component of the system does and what information is exchanged among the components.

6.2 The Component of the System Architecture

System architecture consists of three components: User service requirement identification, logical architecture and physical architecture.

6.2.1 User Service Requirement Identification

Defines the primary objective of the architecture to provide a framework around which multiple design approaches can be developed.

6.2.1.1 Requirement Definition:

a-Objective: Improve safety of travel on route 114 through helping reduce the number of head - on collisions, by discouraging violating drivers from continuing risky maneuvers in the defined "blind area".

b- Medium: Establishing an Intelligent Transportation System able to detect a violator and warn him or her to go back to his original right lane.

c- System requirement

1-Sensors to detect the violators as he or she crosses the double yellow line.

2-Decision making algorithm to activate warning system components.

3-Driver/system interface.

4-System outcome finally depends on the human behavior reaction under those specified conditions whether the driver obeys or not to the warning messages (Figure 6-1).

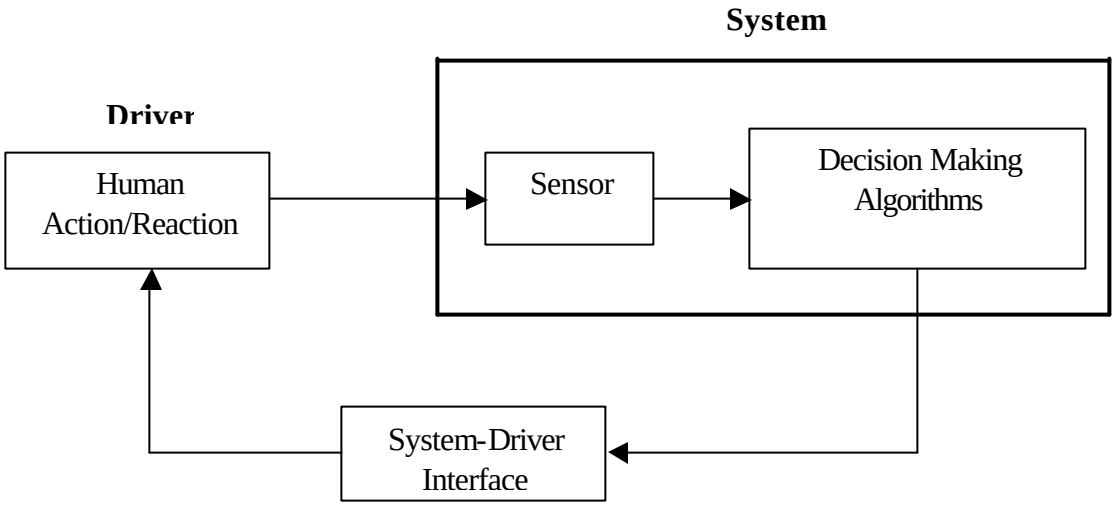

Figure 6-1. System Requirement Definition

6.2.2 Logical Architecture

Describes what function ought to be performed within the architectural framework (such as gathering data, or giving a warning). It is a direct response to satisfying user service requirements.

System function is constituted of two main components:

1- Detection function

2- Warning function

Two other functions (or subsystems) are needed to support main functions and enable them to carry out their missions. These two subsystems are:

3- Central processor

4- Communication network

Figure 6-2 shows the system functional design listed above.

6.2.2.1 Detection function

Detection is performed through a video image surveillance system that monitors and detects violations committed in the NO-passing zone located within the coverage area (image frame or

field of vision) by the drivers who are crossing the two double-yellow line in order to make their passing maneuver.

Such violation move will be detected and verified by an endogenous algorithm. Once the violation is detected and confirmed, the algorithm will trigger a warning system to influence the violating driver behavior and make him or her resume the original path in the right lane.

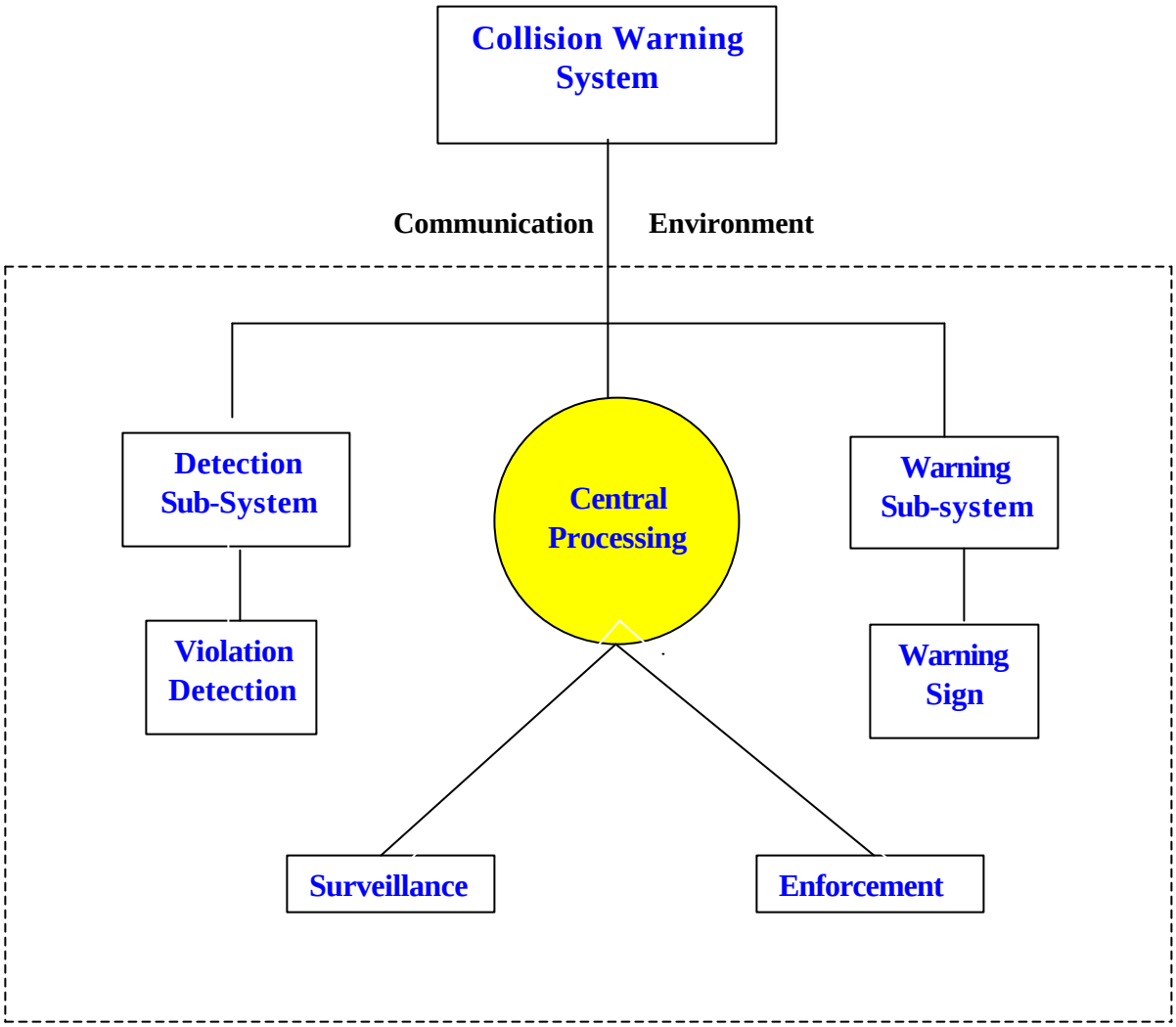

Figure 6-2. System Functional Design

6.2.2.2 Warning Function

Warning sub system is a passive function activated by detection subsystem when an act of violation takes place. It is the tool by which the system tries to intervene with the violating driver in order to alter its illegal action and push him or her to resume the original way.

The warning system consists of a system interface with drivers (like a static or variable message sign). It consists of a device (like an electronic panel) able to send predefined messages depending on the situation conditions. Two messages can be sent by the system:
a- The first is when the detection system verifies and confirms the occurrence of a violation.
b- The second could be designed is to alert the violators in the case when an oncoming car appeared in the field of detection. Therefore it is conditional in the sense that it would not be sent unless there is a risk of a collision with an opposing vehicle.

6.2.2.3 Central Processor

It is the brain of the system. It is a centralized microprocessor that controls the various system components. The processor will perform the following functions:

1- Control, command and monitor the system resources.
2- Collect and analyze data for the various functions such as analyzing sensors data for no-passing zone violation, based on some built-in algorithms, and calculating traffic flow parameters (presence, speed, volume).
3- Activate/deactivate the warning device and send messages.
4- Activate the camera to capture the licensee plate photo of the violating vehicle

6.2.2.4 Communication Network

It consists of the local network (LAN) that interconnects the various cooperating devices enabling them to exchange data. Typically data transfer within system network takes place between a source and a destination through a transmitter to a receiver via a channel (or transmission medium). Certain protocols and standards, which are sets of rules and formats that govern the communication between peer entities of the network, control the ways the data is transferred and received among the different network components.

6.2.2.5 Secondary Functions

Several secondary functions are performed by the system and could be considered as by-products. These function are not essential part of the system and do not affect its effectiveness as a warning and collision avoidance system. However, they add quality to the system performance and help in supporting other important tasks.

Two secondary functions could be identified:

1- Enforcement function: is a function that will be performed in parallel with the warning system, which is video image enforcement that would be activated as the vehicle violation is detected and verified. Video image enforcement includes video recording and license plate image capture.

2- Surveillance function: The video image detection subsystem provides the tool to collect meaningful data in terms of traffic volume, average speed, and density, which would help for future planning studies.

6.2.2.6 System Dataflow

The system manipulates three types of data: input data, processing data, and output data.
The input data are those detected by surveillance subsystem and consists of the series of signal pulses caught by detection sensors. These data are then processed by the microprocessor with its built-in algorithm software, which make the system capable of comparing whether a certain threshold was met and verified, such as when a vehicle crosses the double yellow line. Once confirmed, the microprocessor runs other types of algorithm to activate the warning system and start recording with the video camera and may capture the ID of the violating vehicle. Also, The system could even be designed to make a direct contact with the control center.

Data are saved into two forms:

- In form of algorithm software with which the input are analyzed, and the subsystems are run.
- In form of databases such as traffic data surveyed and license plates shots. Traffic data are digitized and saved in the controller memory as electronic files. The photo shots are saved on wet films labeled with date and time for further processing.

The databases are retrieved in form of reports such as traffic characteristics. Also they are of great importance, for they are live document and evidence in any enforcement action or legal disputes if a crash takes place.

The figure 6-3 below depicts a schematic diagram of system data flow.

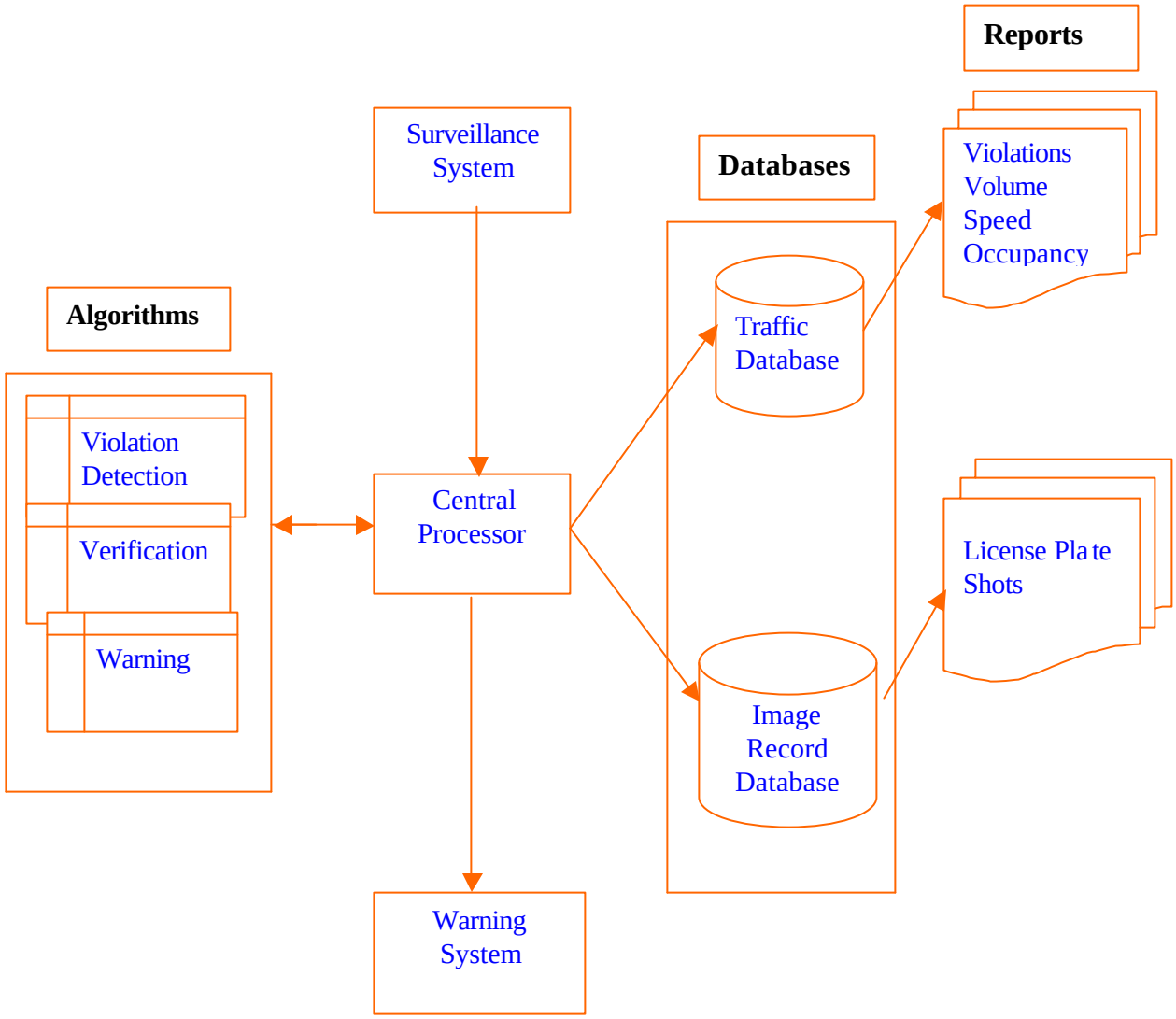

Figure 6-3. System Data Flow Diagram

6.2.3- Physical Architecture

Defines physical entities or subsystems where the system functions reside and describes how system components should be linked, including the interfaces / information flows between the physical subsystems and the communications requirements for the information flows (wire line or wireless). In addition it specifies the requirements for the standards needed to support regional interoperability. Figure 6-4 shows system architecture and the various subsystem components.

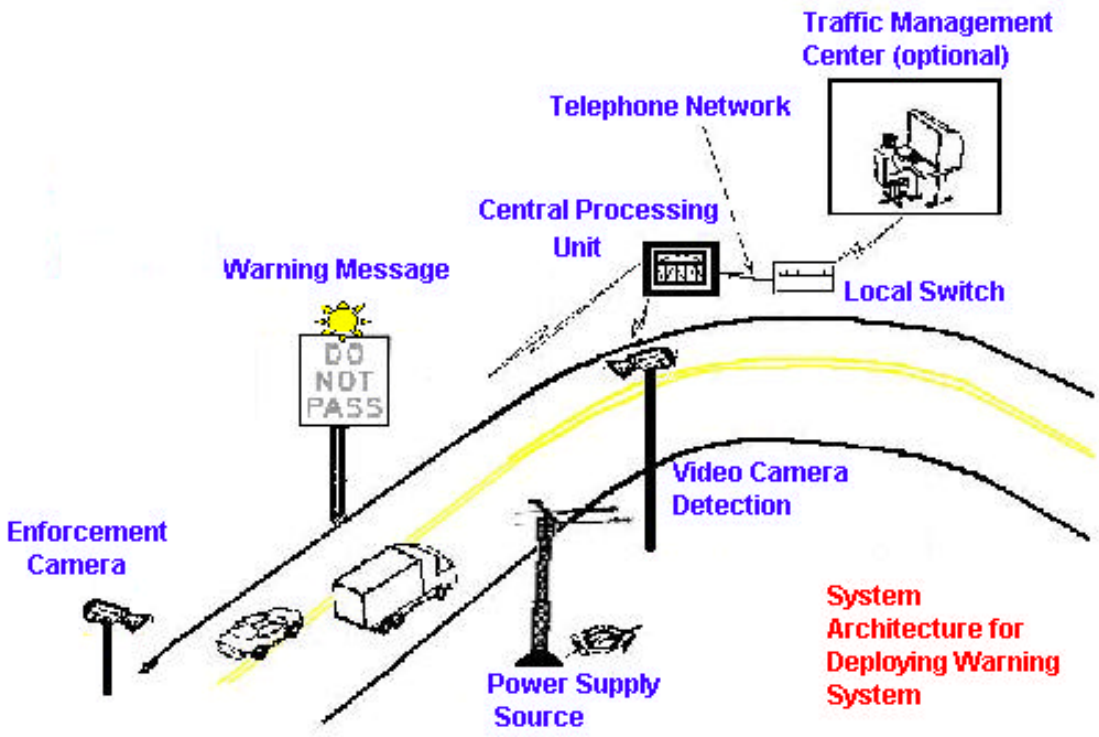

Figure 6-4. Physical Architecture of the System