Detection and Location of Off-the-Shoulder Vehicles

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• THE MODERN Interstate highway is truly a boon to the motorist. By using these highways, he will ultimately be able to drive between most major cities without red lights, stop signs, intersections, school zones, or five o'clock rush hours. In short, driving will be smooth sailing. Smooth, that is, if his car doesn't stop running for one reason or another. Statistics probably show that the average motorist will have one breakdown (mechanical or otherwise) for each x miles of freeway driving. No one pays much attention to these figures until he becomes part of them. Because the Federal government has ruled that there will be no service stations on any new Interstate highway, the stranded motorist is faced with a dilemma. In short, he is at the mercy of time, space, white handkerchiefs, and passing motorists. How to help this unfortunate driver is but one part of the highway research program being conducted at the Antenna Laboratory, Department of Electrical Engineering, Ohio State University.

GUIDED EVOLUTION

An over-all philosophy for the design and implementation of electronics for the highway has been developed. This philosphy is called "Guided Evolution," and may be described as follows: Ultimate goals for the ideal electronic highway have been set, and steps for accomplishing these goals have been outlined. Guided evolution requires that each new development, each new device, be an integral part of this long-range plan and compatible with the ultimate goal. The purpose of guided evolution is to prevent successive installation and removal of isolated gadgets that, although they may provide temporary solutions to a part of the problem, do not appear in the final picture. Ultimately, the location of an off-the-shoulder vehicle will be relayed to a central station automatically, requiring no action whatsoever by the motorist. This goal, however, is probably not realizable in the next several years. On the other hand, the problem is serious enough that an immediate step should be taken to aid the stranded motorist and yet maintain compatibility with the guided evolution goals.

INTERIM SOLUTIONS

Several interim solutions are available for the stranded motorist problem. Some of these will only detect the presence of an off-the-shoulder vehicle, whereas others locate him as well. Those serving only to detect will not be discussed inasmuch as detection without location serves practically no useful purpose. Of the systems that locate an off-the-shoulder vehicle, some require action by the motorist and others do not. These systems are discussed according to this classification.

The following are systems requiring driver action: A telephone system, either conventional or sound-powered, could be installed along the highway. This in effect would set up a communication network between the driver and a central location, and the exact nature of the motorist's difficulty could be transmitted. Another type of system complete with solar batteries and digital encoders has been developed by Hoffman Electronics. In this system, the motorist merely pushes a button on a call-box (located at ½-mi intervals) and signals his location and the nature of his difficulty to a central station. North Electric Company in Ohio has a system that, although it was designed primarily for setting and adjusting road signs from a remote location, can incorporate telephone circuits to aid the stranded motorist. This system also has a protection feature whereby a signal is received if a telephone is disconnected. This might at least retard vandalism to some extent. Finally, an effective interim solution would be the application of a technique long used by power companies in locating short circuits in power lines; that is, the measurement of resistance. The installation of a system of this type requires the following steps: burying a cable along both sides of the highway to be instrumented; placing switches at ½-mi intervals along this cable which can short-circuit the cable; placing resistance-measuring equipment including a bridge circuit, a power supply, a digital voltmeter, and an alarm in a central station. Thus, when the motorist throws the nearest shorting switch, an alarm in the central station announces that a motorist is stranded, and the digital voltmeter gives a numerical indication of the location of the motorist. A further refinement, which could be installed at nominal cost, is an indicator light mounted near the shorting switch. This would come on when the signal is sent by the motorist, and be reset from the central location when help is dispatched. Thus the motorist knows when his distress signal has been received.

Systems requiring no driver action have one feature in common: the only requirement for their operation is that a vehicle be driven off the shoulder of the highway. Thus, in considering possible approaches, one needs only to list various methods whereby the presence of a vehicle may be detected (with a time delay, of course, to eliminate false alarm signals from vehicles that leave the highway temporarily and return). Any detector, therefore, whether magnetic, electronic, infrared, mechanical, or other, may serve as the basis for this type of system. The outstanding feature of all of these is that no action by the driver is required. This technique is in strict accord with the principles of guided evolution, and will eventually be used. For the present, however, a system of this type is not feasible because it is only an efficient method if used as part of the ultimate electronic highway. This is due to the nature of the over-all system and to the condition that if parts of the system were to be installed separately, there would necessarily be duplication of many components.

Based on the foregoing reasoning, only the systems requiring driver action are compared. The installation of a telephone network between the highway and a central station would be an excellent solution to the stranded motorist problem except for one major drawback. The presence of telephone equipment on the highway is an open invitation to vandalism and it is well known that the loss of such equipment is relatively high. The Hoffman System, or one comparable to it, has as its main drawback its high installation cost. It is felt that because of this, it is too costly to be used as an interim measure. Furthermore, it is not compatible with guided evolution because it requires action by the motorist. Finally, although the resistance-measuring system is not thought of as a final solution, its cost of installation makes it very appealing as an interim measure. Moreover, it requires no expensive components (such as telephones) in remote locations. If a more precise communication is desired, it would be relatively easy to devise a code whereby the motorist could "talk" to the monitor in the central location. Finally, pertaining to the guided evolution concept, the cable itself could ultimately be used to deliver power to the electronic circuitry required in the final version of the electronic highway.

SUMMARY AND CONCLUSIONS

Of all the systems discussed as possible temporary solutions to the problem of the stranded motorist, the technique involving resistance measurements appears to be most satisfactory. The reasons for this conclusion are as follows: It has no expensive components (such as telephones or solar batteries) that may be stolen. It has a relatively low initial cost as compared with an elaborate digital system. Finally, the resistance-measuring technique gives the motorist a signal that help is on the way, as well as allowing him to specify (in code) the nature of his difficulty. On realization of the ultimate electronic highway, according to the principles of guided evolution, the buried cable can be utilized in the delivery of power to the electronic circuits.

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