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IN-VEHICLE INFORMATION SYSTEMS

ABSTRACT

The work considers different information systems, including the information systems with ***autonomous units,*** *which carry all their intelligence around with them, and those with* ***communicating units,*** *which inform the motorist about the current situation of the road system by radio or other means. The symbols of various messages have three main objectives: to provide instruction, to warn of oncoming danger, or to give advice regarding parking or looking for alternative routes. When not used for these purposes, they are used to provide general information about the weather, temperature or possible attractions. The in-vehicle information systems try to assist the motorist in driving, and they are promoted as part of the comprehensive intelligent transport system.*

KEY WORDS

information systems, traffic route, information broadcast by radio, coded broadcasts, hybrid systems

1. INFORMATION SYSTEMS WITH AUTONOMOUS UNITS

Systems with autonomous units use onboard computers equipped with information about the road network and methods of determining vehicle's current location in order to help the motorist in selecting the route to the wanted destination.

The disadvantage of this system lies in the fact that autonomous units cannot know the current traffic conditions, and cannot offer the optimal route. They are of special significance for the motorists who are not familiar with the road network and whose main aim is to reach the destination without getting lost.

The information systems using autonomous units reduce the excess mileage and the travel time regarding motorists who make navigation mistakes due to their lack of knowledge about the road network, and at the same time increase driving safety by reducing the level of stress, frustration and confusion among such drivers.

2. SYSTEMS WITH COMMUNICATING UNITS

In these systems, onboard computers keep track of the current location by reference to the global positioning satellites under GPNS, (e.g. GPS or GLONASS), or in relation to terrestrial beacons such as radio transmitters. In order to supplement or replace information, they make use of internally calculated trajectories based on "dead reckoning" using known distances according to the odometer combined with magnetic or gyroscopic compass bearing information.

None of these positioning techniques is completely accurate, since some parts of the town are likely to be in shadow for satellites and "dead reckoning" method suffers from accumulation of errors. In order to reduce the level of error, some navigation systems use a combination of technologies and/or map-matching software, using the information about the road alignments in the vicinity to determine which road the vehicle is most likely to be on.

When the vehicle's current location is established, the in-vehicle unit (IVU) provides the driver with information on the street map stored in the memory, and can calculate the optimal route to the specified destination (previously keyed in by the driver), as well as a series of turn instructions given by text, voice synthesis or symbolic arrows.

In order to increase road safety, voice given instructions are preferred over maps showing current location.

Various techniques of communicating with drivers are being developed fast and currently a number of new systems are being developed in Japan, Europe, and North America.

2.1. Types of communicating units

There are a number of different types of communicating units in use or being developed.

- information broadcast by radio,
- coded broadcasts (RDS-TMC and radio paging)

– hybrid systems (navigators with communication links)

Information broadcast by radio

Conventional radio broadcasts of traffic bulletins have long been an important source of information to the road users. Radio broadcasts as source of information for the drivers are relatively untargeted and intermittent, and often out of date. This reduces the value of a reliable source of traffic information and causes drivers to seek an alternative.

Information provided by teletext, prior to a journey can also be useful, although teletext is not practical as a source of new information during the journey itself.

The use of observing helicopters, as supplement to the ground-based methods of detecting congestion contributes to providing up-to-date and detailed traffic reports

Coded broadcasts

The Radio Data System (RDS) transmits digital information alongside the "normal" radio programmes. Radios with an appropriate decoder recover these messages and have them delivered in the drivers' preferred language by text display or speech synthesis. In Europe, one RDS channel is reserved for traffic information - Traffic Message Channel (RDS-TMC).

The equipment can be set up to interrupt an existing programme whenever a message is received. The information can also be filtered to include only that information which is likely to be relevant to drivers in the local transmitter's catchment.

Radio paging is a quite different concept than RDS-TMC system, but it achieves a similar end - the transmission of digital information to specially adapted radio receivers. The usage of this technology provides the subscribers with a continuous stream of information indicating the location of traffic congestion anywhere on the national motorway network. This is supplemented by information on roadworks. The source of information on the location of slow-moving traffic is a number of infrared speed detectors at regular intervals along the motorway network.

Hybrid systems - navigators with communication links

One of the examples of such a system is the Japanese AMTICS demonstrator, which in 1992 in Osaka used a dedicated radio broadcast frequency to receive real-time information on an in-vehicle terminal, similar to teletext. One page of this information shows a map display of the road system with the driver's position marked and all the roads colour coded to indicate their current reported speed. Thus, it is technically possible to link the use of an onboard map database (such as a CD-ROM) with real-time information provided by radio, telephone or local beacons.

Another example of a hybrid system is VOLVO DYNAGUIDE system which uses RDS-TMC information to generate a symbolic representation of current congestion conditions on a map display.

A third example, which uses GSM digital mobile telephone system as its communication link is the SOCRATES system under development. The system builds on the CARIN navigator and allows recommendations to be based on information about current road conditions.

An alternative approach that uses massive information-carrying capacity of roadside infra-red or microwave beacons, is to dispense entirely with the onboard map and use the roadside beacons to transmit the route information, the so-called EUROSCOUT system. It uses short-range infrared beacons attached to traffic signal posts or other roadside objects. These beacons transmit to passing vehicles information about the best routes to all possible destination zones. Knowing its driver's intended destination, the in-vehicle unit then uses its autonomous dead reckoning and map matching functions to keep track of its position, and to trigger turn instructions to the driver at appropriate points in the network. These instructions can be given by a pictogram display and/or synthesised voice.

The central storage of the map database in EUROSCOUT allows rapid updating of the network and real-time processing of route recommendation being transmitted to the drivers during journey.

3. THE PROBLEM OF THE AMOUNT OF IN-VEHICLE INFORMATION

Potential drawbacks are that the systems may:

– be dangerous because they distract drivers,
– encourage drivers to use secondary links which are environmentally sensitive,
– increase congestion by concentrating traffic on "advised" routes,
– encourage people to use private transport more than they might otherwise have done.

Even if in-vehicle units offer information that distract the driver, the research has proven that the stress effect, and thus the *safety* are less endangered than if the driver tried to read a map or all road signs while driving. Well designed interface relying on speech synthesis and control, rather than text or map with a series of control keys, reduces distraction to a minimum.

In relation to the use of *secondary routes* they can be left out of the guidance network. This raises the issue of the quality and credibility of the advice given by a system which omitted for example all residential streets.

A technical solution available to overcome the problem of concentrating traffic on *advised routes* is

known as multi-routing technique. It could be applied to spread the traffic over a number of different routes. The advice message could be so phrased that not all drivers would choose to use the same alternative route.

On the wider policy question of possible increases in the amount of private travel in response to improvements in journey time and comfort offered by information and advice systems, there remains considerable uncertainty.

Additional potential benefits of in-vehicle guidance and information to drivers include more efficient use of the available network capacity, and reductions in congestion and its negative environmental effects.

Modelling work has confirmed that these benefits would be impressive if the guidance and information systems were to be co-ordinated with road user charging and conventional traffic control signals.

3.1. Route selection criteria

Most drivers choose routes in order to minimise travel time. One part of routes is chosen with other criteria in mind:

- avoidance of queues,
- avoidance of particular types of roads,
- hazardous manoeuvres,
- scenic quality,
- ease of route finding.

The routes have to be based on minimising the travel time both from the standpoint of the driver or the network as a whole. The approach based on the networks designed to exclude environmentally sensitive links (residential zones) will cause the drivers to doubt whether they are receiving the best possible advice and they will not use the system. It is important that the users believe they are receiving the best possible advice.

3.2. Sources of information

The characteristics of the described systems require a traffic information centre receiving data from a variety of sources:

- motorway authorities,
- public utilities for utilities roadworks,
- police for information about accidents and other incidents, automatic network-state detectors, e.g. automatic traffic counters, infra-red TrafficMaster detectors, and other specialised detectors,
- probe vehicles which transmit speed profile data to the control centre.
- historic data on high speeds that indicate the speeds likely to be experienced on a particular link at a particular time of day.

These sources offer high-quality real-time database on road network conditions which can service VMS and teletext, as well as radio broadcast, RDS-TMC and other in-vehicle information systems.

Another, completely different source of information relates to the provision of services available to travellers and about potential attractions which might influence heir route or destination.A system which provides the driver with the quickest route to a theme park via a petrol station or a shop, finds its application, especially since these are free of charge.

Various message signs (VMS) are different from conventional traffic signs because they can be designed so as to indicate a number of different messages that vary according to the current need. Information about standstills and alternatives saves travellers' time offering alternative routes. However, their main influence is on reducing the uncertainty and stress.

SAŽETAK

INFORMACIJSKI SUSTAVI U VOZILU

U radu su razmotreni različiti informacijski sustavi i to sustav s ***autonomnim jedinicama*** *informiranja i onih s* ***komunikacijsim jedinicama****, koji pomoću radija ili drugih sredstava informiraju vozača o trenutnom stanju cestovnog sustava. Informacijski znakovi različitih poruka imaju tri glavna cilja: upućivanje vozača, upozorenje na dolazeću opasnost te savjetovanje glede parkiranja ili traženja alternativnih pravca. Kada se ne koriste u ove svrhe informacijski sustavi se koriste za davanje općih informacija o atmosferskom vremenu, temperaturi zraka ili o potencijalnim atrakcijama na prometnicama.*

Informacijski sustavi u vozilu pomažu vozaču u vožnji, te se promoviraju kao dio opsežnog inteligentnog transportnog sustava.

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