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HUMAN MACHINE INTERFACE RESEARCH AND ITS DEVELOPMENT

Summary. Road telematic and driver assistance systems can constitute a real opportunity to support mobility and to improve road safety. Nevertheless, it is necessary to conceive them according to users' needs and requirements, in order to ensure their acceptability and to detect potential harmful effects of their widespread use.

BADANIE INTERFEJSU CZŁOWIEK-MASZYNA I ROZWÓJ ITS

Streszczenie. Systemy telematki drogowej i wspomaganie kierowców mogą stanowić prawdziwą okazję do wspierania mobilności i poprawy bezpieczeństwa. Niezależnie od tego konieczne jest jednak opracowanie ich zgodnie z wymaganiami i potrzebami użytkownika, w celu zapewnienia ich odpowiedniości i wykrycia potencjalnych szkodliwych skutków szerszego zastosowania.

1. INTRODUCTION

The study of driver behaviour is essential to the safe implementation of new traffic control systems. Into this context of increasing demands placed on drivers in a complex environment, vehicle manufacturers are introducing a broad array of new technologies. Whilst the motivation is driver comfort, there are plenty of opportunities, and pitfalls, for safety that this new technology provides.

It is clear that the development and supply of In-Vehicle Information Systems (IVIS) is not taking place in a context of discovering and providing for the information handling capacities of drivers. In addition, the increasing use of mobile phones, GPS based navigation systems and even DVD in cars is almost certainly leading to accidents.

Vehicle manufacture and the development of techniques such as intelligent speed adaptation take place on a European-wide basis. It is vital for policy makers, both in government and industry, to understand the individual and cumulative effects of this growth in IVIS on the capabilities of drivers to manage their vehicles in safety.

2. EUROPEAN RESEARCH PROGRAMMES - HUMANIST AND COST 352

Most of the information received by drivers to help them complete their journey in comfort and safety is visual, in the form of signs and road markings. This is what drivers have learned and become used to, though they are now increasingly confronted by a new array of information sources, such as audible congestion warnings and GPS (Geographical Positioning Systems) driven mapping systems. In the near future, commonly available cars and trucks will be equipped with interactive congestion warnings, collision avoidance systems and intelligent speed adaptation, to name but a few, mostly as standard equipment purchased together with them. The potential for information overload on drivers is clear.

In order to make the best use of increasingly congested road space and signing (e.g. fixed road signs, road markings, temporary road maintenance signing, variable message signing), traffic engineers are devising more and more sophisticated traffic management systems. These add considerably to the complexity of the driving task.

The present state of accident reporting, although incomplete, indicates that an increasing number of road accidents are caused by the misuse or abuse of such devices as mobile phones, GPS display boards, etc. in vehicles

As more comprehensive traffic information becomes available to route managers, they will resort to diverting traffic away from congested sectors of the network. This places additional strain on drivers who are taken away from familiar routes. In many cases the direction signing on diversion routes has not been designed with that purpose in mind, the resulting lack of clear information being likely to result in confusion and poor driving decisions, with the risk of creating hazardous situations.

3. HUMANIST NoE SCIENTIFIC SCOPE

Human factors and cognitive engineering competencies exist in Europe but are scattered. For addressing this fragmentation of research capacities, HUMANIST gathers the most relevant European research institutes involved in Road Safety and Transport to contribute to the eSafety initiative and to improve road safety by promoting human centred design for IVIS and ADAS.

This integration will allow us to increase Societal Benefits of ITS implementation, to harmonise ITS approaches among State Members, to react quickly to any new technological developments and to face international challenges by producing state of the art research, identifying knowledge gaps, avoiding redundancy of research activities.

The goal of HUMANIST is to create a European Virtual Centre of Excellence on HUMAN centred design for Information Society Technologies applied to Road Transport (IVIS and ADAS), with a coherent joint program of activities, gathering research, integrating and spreading activities. Research work is carried out in scientific task groups:

- a) Identification of the driver needs in relation to ITS.
- b) Evaluation of ITS potential benefits.
- c) Joint-cognitive models of Driver-Vehicle-Environment for User-Centered Design.
- d) Impact analysis of ITS on driving behaviour.
- e) Development of innovative methodologies to evaluate ITS safety and usability.
- f) Drivers' education and training for ITS use.
- g) Use of ITS to train and to educate drivers.

Integrating Activities will permit to manage and to consolidate the NoE structure by promoting the mobility of researchers, by optimising the pool of existing experimental infrastructures, by setting up electronic tools (common database, web-conference, e-learning) for knowledge sharing.

Spreading Activities will allow us to spread widely the knowledge from HUMANIST, by organising debates with RTD projects on eSafety and relevant stakeholders, by promoting harmonisation with standardisation and pre-normative bodies, by setting up training programmes, and by promoting and disseminating research results to a wide audience.

Mobility program HUMANIST Centre of Excellence enables close co-operation among European research institutions, which is especially important for young researchers – PhD students and post-docs. This program gives opportunity to share expensive and unique infrastructure of collaborating institutions, usually not available at home. But the greatest benefit of the program is creation of the opportunity to be involved in important international projects and gain the unique professional experience in very quick and efficient way. They can present, share and defend their ideas, thesis, hypotheses and methodological approaches with international scientific community, professors and PhD students from other countries, with different scientific approaches and cultural background. They can learn the scientific procedures on site and get so much unique information, which is not available in single institution or university at home. The latest experiences show many advantages compared to the other PhD students without this unique experience and give proof of scientific maturity of HUMANIST youth.

4. COST C352 SCIENTIFIC SCOPE

Recent projects in this field have been mostly focused on the technical issues, improvement of driving conditions, drivers' comfort and positive impact on fluidity of road traffic and reduced congestion, while safety aspects have been only a complementary output. Much of the uncertainty regarding the actual safety effects of specific IVIS is due to inefficient and/or non-existent safety evaluation methodology.

This COST Action has the purpose to harmonise the methods of testing and evaluation of modern in-vehicle equipment and its impact on road safety under various conditions existing in the European countries in order to improve the road safety throughout the whole Europe¹. COST co-operation provides the right framework to bring together experts from many European countries, to share their national practice and experience, discuss the subjects mentioned and to realise an integrative analysis.

The COST Action will devise and test safety evaluation methodologies. These will be used to test the reaction of drivers of all abilities in specific situations with more than one IVIS input to the driver. Although tests have taken place of individual devices, this COST Action will evaluate their influence when used in combination



Fig. 1. Information systems can cause drivers distraction

Rys. 1. Systemy informacyjne mogą powodować rozpraszanie uwagi kierowcy

¹ Membership The 11 COST signatory countries which are actively participating in the Action are:
Austria – Czech Republic – France – Germany – Italy – Lithuania – Netherlands - Norway - Poland - Portugal – Switzerland.

5. OBJECTIVES AND BENEFITS

The main objective of the Action is to enhance road safety through the proper use of In-Vehicle Information Systems (IVIS).

Secondary objectives are:

- establish the effects of increasing amounts of information available to drivers, through IVIS;
- demonstrate how they contribute to driver distraction in road environments where outside information is normally provided;
- in order to create a scientific base for: safety evaluation methodology;
- rules for drivers education and training;
- road traffic and vehicle equipment legislation in the relevant area.

The knowledge gained will inform policy makers and industry about how to respond to the increasing range and availability of IVIS equipment.

Technical development and commercial realisation of IVIS are moving rapidly and Road Safety policy with respect to these systems therefore needs to be dynamic and flexible to encourage, restrict or influence developments. IVIS can be used by private and commercial drivers in a range of vehicles for different applications and under different traffic conditions. The impact on road safety will depend on how the systems are implemented, the users are informed and the devices used.

Existing policy instruments, such as Type Approval, national traffic regulations and driver education, may need to be adapted or applied in new situations arising from the availability of IVIS. Key issues will be identified and thus provide a robust scientific basis to inform policy actions in this developing area.



Fig. 2. Some problems appear when more appliances are in used

Rys. 2. Pojawiające się pewne problemy w przypadku użycia większej liczby urządzeń

6. SCIENTIFIC PROGRAMME

The Programme of the Action can be defined in terms of load on the perceptual (visual, auditory and tactile), central (cognitive) and output resources (hand, foot and vocal).

The scientific programme will concentrate on five main Working packages, each of which is to be divided into tasks as set out below. These tasks will take into consideration drivers of different types of vehicles used privately and / or professionally.

The Action will cover several application areas, which requires specific scientific research depending on the nature of the source of information as well as their respective interaction, as follows:

- in-Vehicle information and guidance devices;

- electronic messaging;
- mobile telephone systems;
- entertainment;
- human information processing.



Fig. 3. Interference of devices
Rys. 3. Interferencja urządzeń

To achieve the above objectives, the following Working packages have been active:

Inventory of existing knowledge. Leader INRETS (France)

This inventory will provide information on the current practices of each source of information mentioned above. Thus the related ongoing and past studies will be listed as preamble to the COST Action research programme. In addition the theoretical and methodological framework of the influence of modern driver information systems will be established in view of the development of the research application.

WPI will not be just a "preamble" to the research programme but will be very important. Indeed, simulator and real traffic studies are expensive and could soon cost a lot of money, testing even just a few parameters. It is therefore important that such studies are carefully targeted. Several other institutes are carrying out similar work. The COST Action will collaborate with these.

In December 2006 the first COST 352 publication will be disseminated in the form of a hard copy published jointly by COST 352, INRETS and HUMANIST. It will also be available on both the official COST website and the COST 352 website.

Driver behaviour study preparative. Leader BAST (Germany)

This is a crucial task leading to the intended research of the Action. The methodologies of theoretical (simulation) and practical (real traffic conditions) driver behaviour research will be established based on existing knowledge. More specifically, the preparative should prepare the methodologies for the studies conducted in simulators and on the open road dealing with the five items mentioned in WP I (In-Vehicle information and guidance devices / electronic messaging / mobile telephone systems / entertainment / human information Processing). It is reasonable to assume that somewhat different methodologies will be used depending on the source of driver information. Psychological research on driver behaviour is to be closely involved for this preparative to qualify links between behaviour and accident risks.

Driver behaviour studies by simulation. Leaders INRETS (France) and Road and Bridge Research Institute (Poland)

Simulation studies shall be carried out if possible in both moving and fixed base simulators. They will be carried out in such a way that the results should be comparable to those undertaken on the open road.

They will concentrate on the admissible levels of distraction and on the driver acceptance of information (comprehension and adherence to the advice offered). The acceptance levels obtained in the simulator(s) will provide scientific information on what can be provided or not to drivers of different types of vehicles in order for them to react and drive safely in real traffic situations.



Fig. 4. Driver's behaviour and response to ADAS and IVIS can be simulated
Rys. 4. Można symulować zachowania i odpowiedzi kierowcy na ADAS oraz IVIS

Driver behaviour studies in real traffic conditions. Leader IVT ETH Zurich (Switzerland)

These studies will involve several disciplines, in order to provide a plausible comparison of the findings in WP III to real driving tasks. Studies to be carried out in real traffic and on driver training tracks will be designed jointly by experts in the fields of traffic engineering, human behaviour and psychology. They should cover situations on different types of roads.

In order to obtain feasible results, several Signatories to this Action will be invited to set up such experiments in their respective countries.



Fig. 5. Naturalistic observation in instrumented car
Rys. 5. Rzeczywista obserwacja w wyposażonym samochodzie

Recommended Practices.

The elaboration of recommended practices will be based on the information obtained in the different Work Packages mentioned above. This will be integrated into the final document presenting conclusions and recommendations prepared by a multi disciplinary team in the different fields touched upon by the research with the aim of providing

Policy and decision makers within government authorities

Standard organisations
Industry.

It will provide clear indications based on scientific facts for elaborating policy decisions, product design and technical approval leading to enhanced road safety.²

Further research requirements.

By elaborating recommended methodologies and research actions, this COST Action has already identified several needs for further research in many precise fields. Also, in the coming years, developments of new and/or improved information devices and telematics systems will certainly be commercialised. These will have to be considered as far as possible in the current Action, in a recommendation to initiate new European research projects.



Fig. 6. Type of JKZ Olomouc simulator used in Brno, Czech Republic
Rys. 6. Symulator typu JKZ Olomouc używany w Brnie, Republika Czeska

7. CONCLUSION

The final document will contain both a written text and much detailed and essential information derived from the different WP research procedure and results on a CD-ROM. It will be intended to be used by policy makers, authorities and manufacturers of the different information systems discussed in the research as well as elaborated by the dedicated specialised sectors of the automotive industry.

The final results of the Action will be presented to the ITS '08 Congress which is planned to be held in June 2008 in Geneva, Switzerland.

The final document will also discuss recommended practice and programmes for presenting the results of the Action on a national and international level, in particular at congresses and symposia.

² COST Action 352 Website: cost352.epfl.ch



Fig. 7. Useful integration of ADAS and IVIS is proposed
Rys. 7. Proponowana praktyczna integracja ADAS i IVIS

Table 1

Timetable

TASK	YEAR 1	YEAR 2	YEAR 3	YEAR 4
Inventory				
Simulator				
Real traffic				
Final report Recommendations Further Research etc.				
Dissemination				

The total duration of the Action will be four years starting in April 2002 and ending end May 2008. In the table below the proposed timetable of the action is shown.

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Literature

- Bernhard M., Schmeidler, K.: *Preliminary results - Influence of in-vehicle information systems on road safety*. In 6th European Congress and Exhibition on Intelligent Transport Systems and Services: Time for Intelligent Move, Aalborg (Dánsko), 18-20 June 2007 [CD-ROM]. Aalborg (Dánsko): ERTICO ITS Europe, 2007.
- Schmeidler K., Rehnová V., Macků I., Vašek J. et. al.: *Professional drivers and IVIS*. Edited by Corinne B. *The influence of in-vehicle information systems on driver behaviour and road safety: Synthesis of existing knowledge*. 1st ed. Francie: INRETS, 2007, p. 112. ISBN 978-2-85782-650-7.