USING AN EXISTING GPS-BASED FLEET MANAGEMENT SYSTEM FOR ASSESSING THE DRIVING BEHAVIOUR

Alberto Notario-Collado [1], Javier Paniagua-Sanz [2], Carlos Busnadiego-Gutiérrez [2], Arturo González-Escribano [3] , Diego R. Llanos [3]

ABSTRACT

The road sector represents one of the largest mass markets for GNSS applications. Satellite-based Intelligent Transport Systems (ITS) are an important component of the global answer to the challenge raised by increased personal and freight mobility. The continuity, accuracy and availability provided by GNSS-based fleet management applications open the possibility of reducing the negative impact of road transport while offering new services to a wide range of transport actors.

The GMV Company and the University of Valladolid have joined their efforts in order to explore the potential of PALVIEW®, an open, robust and scalable technical platform integrating a large number of road applications. In particular, this article focuses on the generation of driving profiles in order to know the behaviour of the drivers. This information is crucial for different actors because the factors that affect the mobility of road users can be derived from these profiles.

INTRODUCTION

“The term intelligent transportation system refers to efforts to add information and communications technology to transport infrastructure and vehicles in an effort to manage factors that typically are at odds with each other, such as vehicles, loads, and routes to improve safety and reduce vehicle wear, transportation times and fuel consumption” (source: Wikipedia).

The GMV Company, that has been involved in the development of ITS systems (in particular Fleet Management applications) since 1997, started the provision of a fleet management service on an web scheme (based on ASP.NET technology) in February 2005 that has resulted in a major success for GMV. This service, called MOVILOC, is based on the PALVIEW® platform, developed entirely by GMV.

This platform allows a vary group of OBUs (On-Board Units) to wirelessly send information to a control centre, where this information is processed and stored. The type of information is very diverse, going from PVT (Position, Velocity and Time) to different sensor data (temperature, tamper detection, diagnosis

[1] Dept. of Computer Science, University of Valladolid & GMV, uvaanc@gmv.com.
[2] GMV, Parque Tecnológico de Castilla y León 101, 47151 Valladolid – Spain
Tel. +34 983 546 554, Fax +34 983 546 553, {japs,ccbg}@gmv.com
[3] Dept. of Computer Science, University of Valladolid,
Tel. +34 983 185 642, Fax +34 983 423 671{arturo,diego}@infor.uva.es.

information, etc), since the philosophy to follow is One OBU – Multiple Services [1][2]. That is, one single type of OBU is able to provide information for very different services like eCall, Pay as You Drive, Electronic Toll Collection, Road Use Charging, Floating Data Car, remote diagnosis, etc.

The main features of PALVIEW® are the following:

- An ASP.NET mode service where end users use a thin client (Internet browser).
- PALVIEW® is a modular platform that differentiates layers depending on the final users.
- PALVIEW® allows the development of other applications by third-party integrators, thanks to an interface based on Web Services provided by the platform to access the stored information.
- Finally, PALVIEW® can integrate various types of mobile devices, including those in this tender, developed and manufactured by GMV.

According to these features, the main advantage of PALVIEW® is that very different services can be quickly developed using a common platform as a core, thanks to the modularity and the interfaces provided by PALVIEW®. During these years GMV has developed several PALVIEW®-based services, like a fleet management system (Moviloc [2]) and ETC and Road User Charging services [3, 4, 5 & 7], etc.

The basic approach for this article is to make use of this common infrastructure (PALVIEW®), which will provide support to all planned services together with specific applications, to develop a new service that, starting with the computed PVT (Position, velocity, Time) information coming from the different mobile units, will generate the risk map related to each user for the calculation of their driving profile. In such way, the service will automatically analyse the stored PVT information in order to present clear reports both in HTML and EXCEL format regarding issues like fatigue report, driven distance, etc. These reports may be requested under demand or automatically generated and sent via email to the service operator.

The aim of this development is to demonstrate the technological feasibility of a specific application experimenting and verifying the new business possibility for the insurance companies and infrastructure competent authorities. Moreover, drivers can also be conscious of their individual emissions of pollution helping to reduce the impact of their vehicles on the environment.

To achieve this, anonymous information stored in PALVIEW® has been used to carry out a set of data analysis using the newly developed service, in order to determine patterns of driving behaviours, and the present contribution shows the results.

EXPERIMENTAL RESULTS

The experiment required the participation of drivers in order to know their corresponding driving behaviour. Since Palview® is a commercial platform and offers its service to more than 5,000 vehicles in Spain, some volunteers were recruited. Two types of vehicles were selected: commercial vehicles and private vehicles. The driving pattern is different in both cases and the experiment looked for assessing the risk profile of suffering an accident of a given user.

The participants in the trial did not require the installation of any equipment because there already carried a commercial GMV OBU. Therefore, the procedure was simple and it was not necessary a continuous exchange of information with the users. Automatically, the platform received the data from the equipments and it was be possible to extract the information relating the driving behaviour.

Some results are depicted in the following graphs. The collection of all the information displayed defines a complete pattern of the driving behaviour of the users. Once the information is obtained, it will be able to be compared with accident statistics ([8], [9]) in order to determine an indicator of the risk of having an accident.

Firstly, the particular use of a vehicle and the distance that the user travels every day can be obtained by splitting the information with respect to the hour of the day. As an example, Figure 1 shows the daily mean driven distance in kilometres of a given vehicle at different time slots. Since a daily journey takes approximately 8 hours during office hours, it can be deduced that the movement of the car corresponds to a company vehicle. This is confirmed in

Figure 2 because the vehicle is only driven during working days, leaving the weekends in blank, without any movement. Therefore, Palview® can automatically detect the use of a vehicle independently from the information that the driver gives when is going to sign a contract with, as an example, an insurance company.

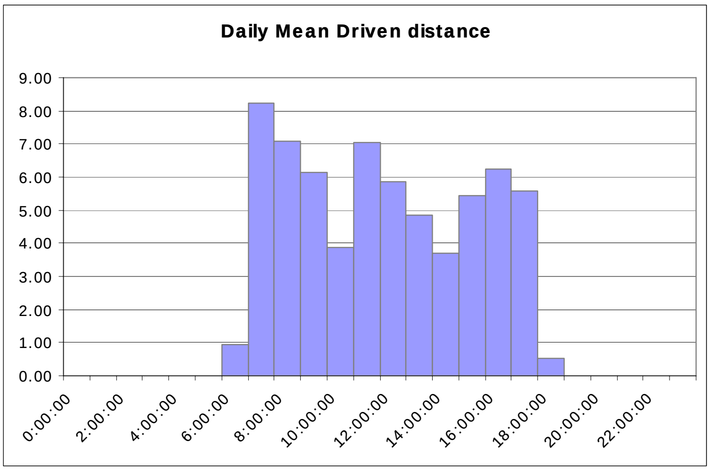

Figure 1 - Total driven distance in a month divided by hours

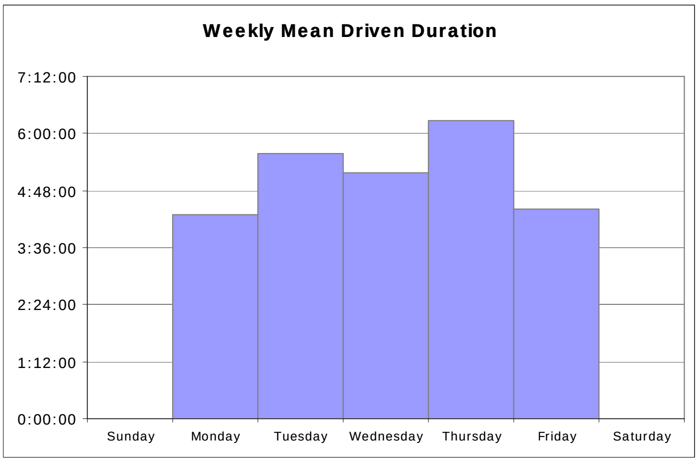

Figure 2 - Total driven time in a month divided by day of week

A particular point of risk for users is the luminosity. Different studies (such as [10]) assess the danger when the user drives by night, especially for young drivers. Thanks to Palview®, this information can be automatically calculated.

Figure 3 represents the percentages of the total driven distance in a given month. One third of the total amount of kilometres are travelled by night, hence it can be translated to a high probability of risk. This particular report is trickier that it may seem, since the definition of "day" and "night" depends on the geographical coordinates of the vehicle at each moment, information that has been taken into account for calculating the corresponding chart of the figure.

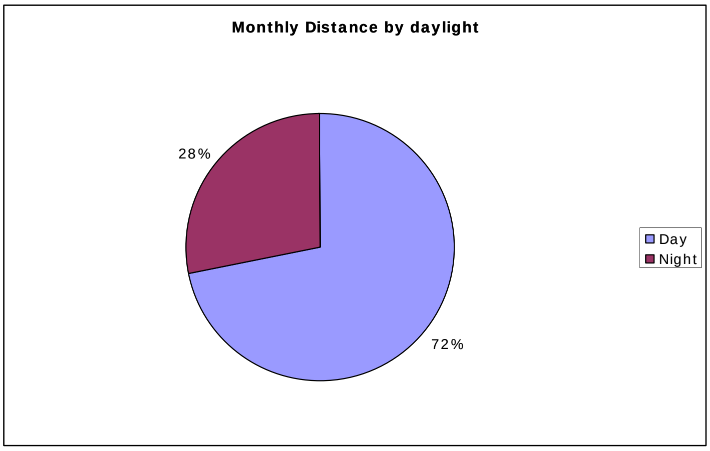

Figure 3 - Total driven distance in a month divided by daylight

The risk of having an accident does not only depend of when the user drives; the area where the user uses to move will also affect to the probability of a crash.
Figure 4 and
Figure 5 show this information for a private vehicle that performs a journey corresponding to a holiday trip between the North of Spain and the South. The first graph shows the total amount of driven kilometres per province in Spain and
Figure 5 depicted the type of road where the vehicle travelled.

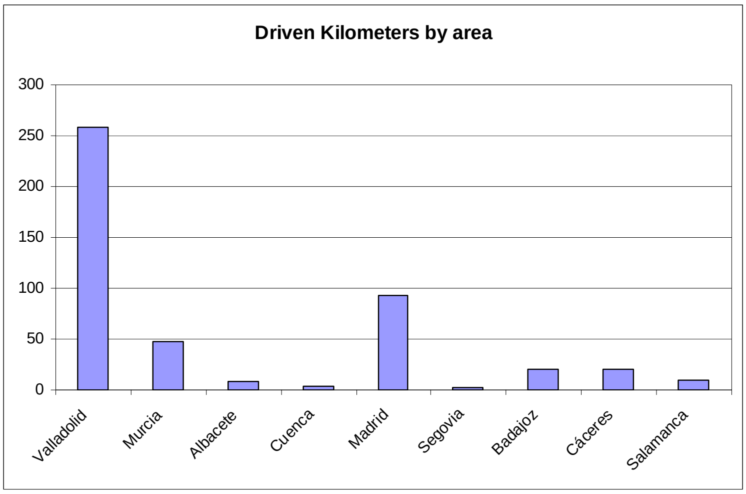

Figure 4 - Total driven distance in a month divided by area

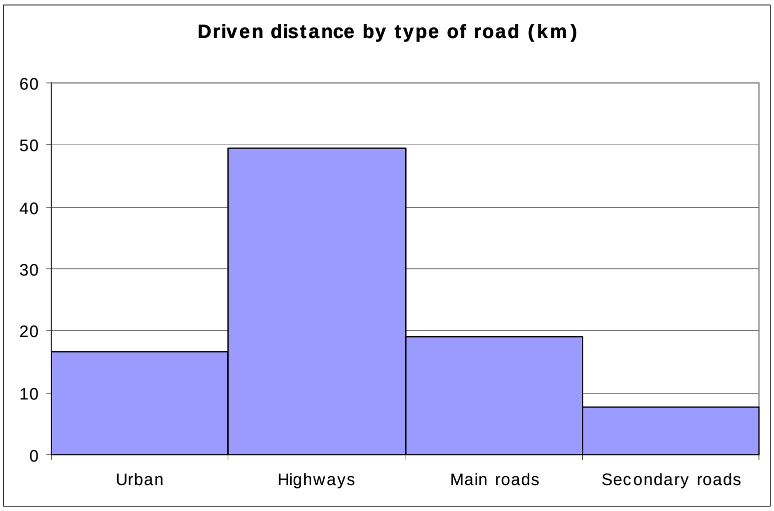

Figure 5 - Total driven distance in a month divided by type of road

A parameter that measures the attitude of the driver is the compliance with the speed limits. An aggressive driver uses to exceed the road speed limitation.

Figure 6 depicts the speed limit of the road where the user is moving and the actual speed of the vehicle. The tests correspond to a private vehicle and it can be seen that its driver sometimes goes above the speed limits, with a maximum value of 120% of that limit.

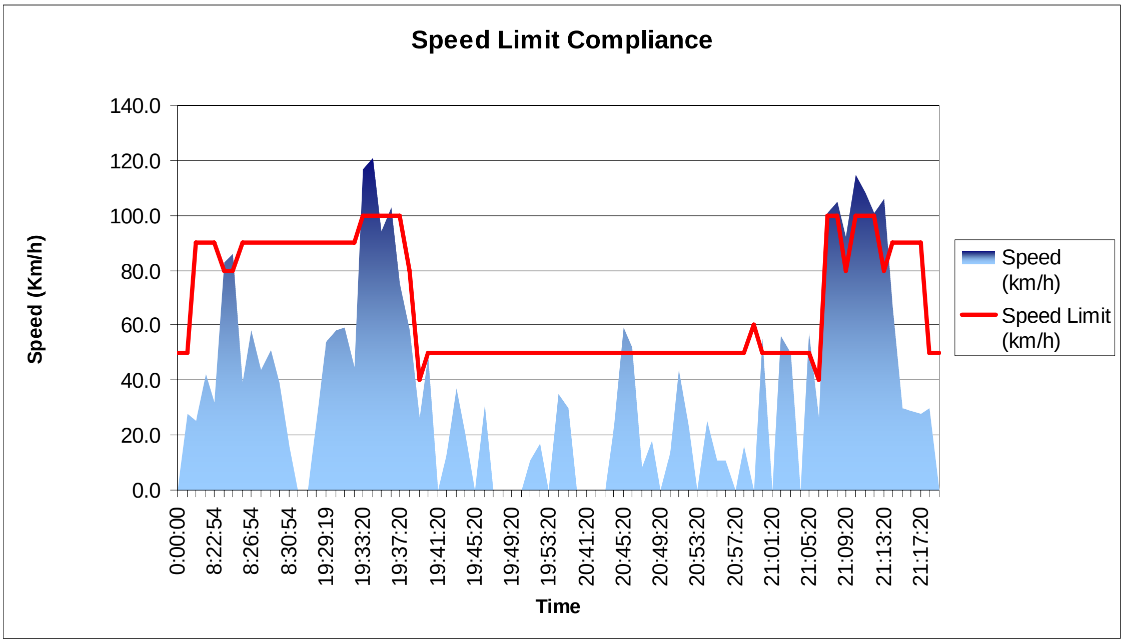

Figure 6 – Speed Limit Compliance

All the information gathered in the different reports previously mentioned has a very high interest for insurance companies, since they can adapt their charging schemes according to the use of the insured car or the driver behaviour. In a first approach, the total driven distance and time have a direct influence in the charged fee, since each travelled kilometre generates a crash risk, risk that would not exist if the vehicle stays parked.

In the same line, considering that insurance companies are more interested in parameters that refer to the probability or risk of accident, the time slots where the user drivers in general and the monthly distance by daylight in particular are also key factors that can be used by the insurers to compute that associated probability of accident for a given vehicle.

Other important information that the insurance companies would like to know is where the vehicles use to travel, since they manage different percentages of risk depending on the specific area. In the provided example, a special tariff could be offered to the user since he drives most of the time across highways, which are considered less-risky than secondary roads

The final coefficient to be applied to each user would be a conjunction of all these factors and other potential ones like fatigue, indoor temperature, routine journeys, etc. Some of them (e.g. fatigue) can already be reported using this platform. Regarding the others, they will be progressively included thanks to the modularity of the platform, with the purpose of allowing insurers to have as much information as possible in order to estimate the associated risk for a given vehicle.

CONCLUSIONS

This contribution is based on an existing technical solution, PALVIEW® a horizontal common platform, which allows serving other applications that will lead to new services in the near future. In particular, insurance companies can take advantage of the information generated by the platform, enabling the concept of "Pay-as-you-drive Insurance". This article has proven how the generated information can be used to determine a driver profile that will lead the insurance companies to establish faired charging schemes according to the user's car usage. In this line the developed tools allow the insurers to answer questions like when, where and how the different users drive, estimating in this way the associated risk for a given vehicle.

To achieve it, no special OBUs are required, since the philosophy "one obu – multiple services" allows to offer these features within all the provided functionalities. Therefore, the tests were carried out with equipments already installed in vehicles belonging to different fleets.

The advantages of a system of this kind for insurance companies are clear, but also for determined vehicle owners, since they can benefit from fairer charging schemes if their usage of the car follows a profile that fix into the low risk rates (sporadic use, low transition across specially dangerous roads, etc).

REFERENCES

[1] Javier Paniagua, Sara Gutiérrez, Rocío Sánchez (2007). GMV. "Proyecto Giroads: Sistema de Peaje Basado en GNSS Sobre Una Plataforma Multiservicio LBS". ITS España 2007

[2] MOVILOC web site. http://www.moviloc.com. Last visited March 2008.

[3] Sara Gutierrez Lanza (2006). GMV. "Introducción de GNSS en el Sector de la Carretera". ITS España 2006

[4] Joaquin Cosmen-Schortmann (2006). GMV. "Method and tool for the analysis and design of GNSS-only ETC system of guaranteed performance". ITS World 2006, London

[5] Report of Expert Group 9 (2006). "Specification of the EFC application based on satellite technologies". DG TREN

[6] J.G. Jordán, F. Soriano, D. Graullera, G. Martín. (2001). "A comparison of different technologies for EFC and other ITS applications". 2001 IEEE Intelligent Transportation Systems Conference Proceedings.

[7] Transport for London (October 2006). "Congestion charging technology trials: Stage 2 final report"

[8] European Road Federation (June 2007). "European Road Statistics 2007"

[9] Spanish Ministry for Transport. "2006 Annual Report"

[10] National Roads Authority of Ireland, "Young Driver Accidents 2000"