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Virtual sailing copilot

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***Abstract*—This paper does an inventory of the navigation systems under development which promise to be key systems in the following decades. But the main aim of the article is to add some complementary tools of the spot light to the navigation systems to assure they arrive at the port, based on information technologies and social structures. Weather Information, conditions of the infrastructure and social movements may be sources of efforts to improve a mature technology. The Global Positioning System shows you the way to get there, but the virtual sailing master shows you how to get there.**

***Keywords—navigation, driver asistence,* copilot.**

I. Introduction

Undoubtedly, the technology related to navigation assistance has changed much since the days of compasses and sextants in the old medieval vessels compared with the currently employed equipment. Thanks to global positioning system, the development of complex electronic equipment and information management, today's technology is within the reach of most people, from carriers in huge land, sea or air to traveling families by their vehicles and even tourists walking with their cell phones in almost any city on this planet.

In 1957, to study the Doppler Effect, the Soviet Union launched the first artificial satellite, the Sputnik 1, in orbit. Scientists noticed that the Doppler Effect could be used to track an object on the earth's surface, and with that in mind, the U.S. Army began the development of a system called TRANSIT, operated in 1964, and was commercially available in 1967. The system was capable of updating an object position every 40 minutes with certain accuracy. By those decades, atomic incorporated to the satellites watches the increasing precision [1].

Later, in 1973, the U.S. Air Force joined efforts with the Army to deploy the Navigation Technology Program (or NAVSTAR GPS), consisting of a new satellite network with codified signals and a pseudo-random noise, fully functional in April 1995.

As to today, twenty four satellites have been distributed in six orbits at 20200 km over the earth surface. The system has evolved to provide an accuracy of 2.5 to 3 meters, whose rate reaches 95%

By 2017 it is expected to reach GPS3 standards allowing 1 meter precision [2].

Currently, several world teams (Table 1) are developing their own systems, which will collaborate with the GPS to increase accuracy in certain areas.

Table 1. Current known navigation systems under development.

System	Origin
Global Navigation Satellite System (GLONASS)	Russia
BeiDou or Compass	China
GALILEO	European Community
Indian Regional Navigation Satellite System (IRNSS)	India
Quasi-Zenith Satellite System (QZSS)	Japan

All of these systems focus on improving accuracy and reducing the effect of the error sources, like ionosphere, stratosphere interference, physical obstacles (like mountains or buildings) and numerical errors, which are mentioned little.

II. Followin the map

Going to a specific place in an unknown city is no longer a problem. Usually, every few miles, the visiting driver has to ask for directions in a gas station or a convenience store. But now it is possible to have a recommendable route from origin place to the final destination. Even if the driver deviates from the suggested route, the system is able to calculate an alternative route (Figure 1).

Figure 1. Typical GPS screen format.

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Most of the time, there is enough information to get to the destination, but there are some factors that could make the task difficult to accomplish.

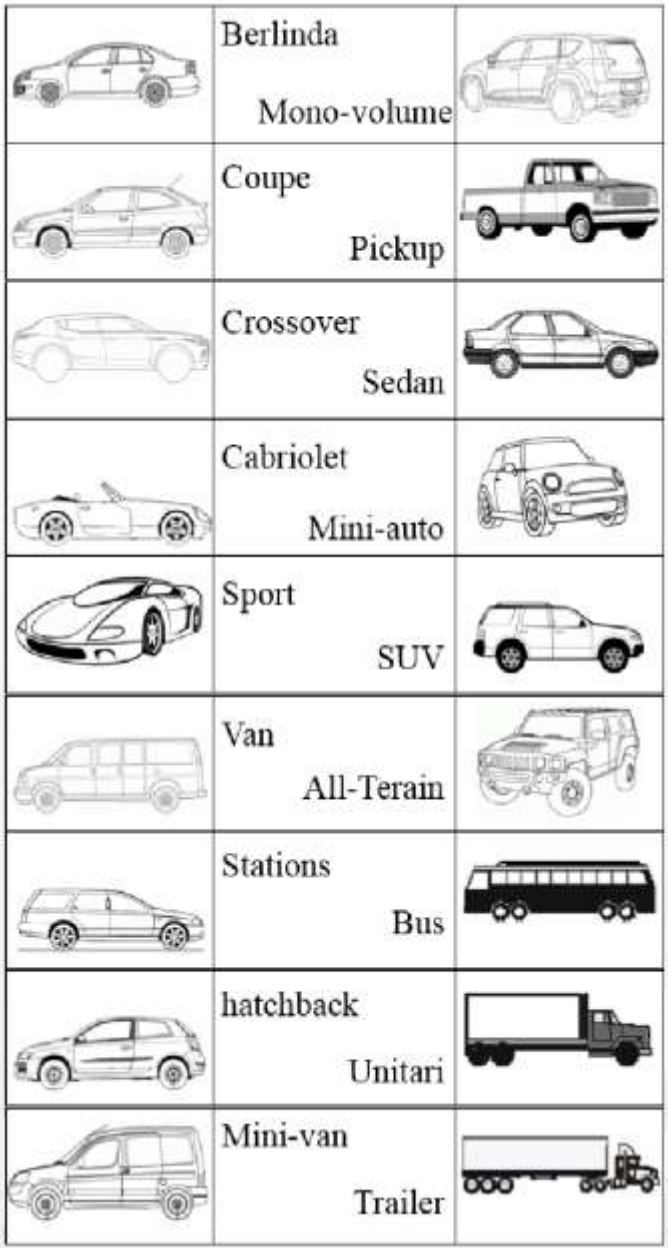

Figure 2. Vehicle classification.

III. Factors to consider

A. *Vehicular configuration*

It is not the same to drive a commercial truck and a trailer or a mini-compact vehicle. The dimensions of the vehicle, weight, weight distribution, and location of the center of gravity, number of passengers, pay load type of suspension, suspended mass, and other factors could make an important difference in order to take a turn at a safe speed, to deal with a road bump, or to cross a bridge. Figure 2 shows the common classification of terrestrial vehicles. Figure 3 represents a simple vehicular model. [3]. And it is not only about safe considerations, local police regulations may apply for some vehicles as well.

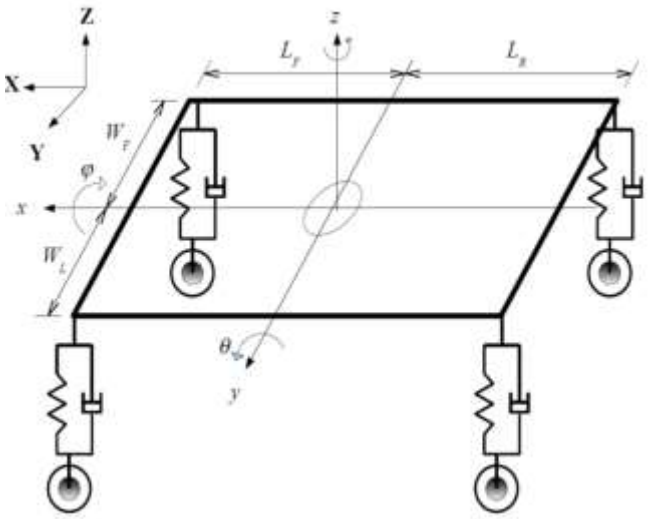

Figure 3. Idealized car suspension.

B. *Infrastructure*

All countries have some dangerous spots in their cities or road networks, which are well known by locals, but not for new travelers. Closed turns, damaged pavements and visual obstacles are sources of emergency maneuvers causing a simply unpleasant surprise in the best case scenario, but important damages to vehicles and passengers may also occur.

Figure 4. Stelvio Valtellina, at Adigio's valley, Italy. ElFinanciero. 2013.

Figure 5. Blind turn in a damaged road. Marrakech, about 20 minutes from Col du Tichka. Pictured by Kevin KL. 2007.

This information could be included in the database to warn the driver on time with minimum computational effort, and the participation of local authorities. Figures 4 to 5 show different infrastructure factors. [4].

Other simple examples are wedge-plateau bumps in tortuous areas, or road designs without any consideration of the vehicular needs. Most of the factors are included as infrastructure remains in time, so it is important to let the drivers know about them.

C. *Temporary detours*

Other different sources of inconveniences while driving are not permanent, and it is not possible to know their impact or duration.

They depend on two main causes, people's behavior and weather conditions. Figure 6 shows a scene of protestors blocking an important street while they march to the main square plaza. Vehicles have to wait for hours before being able to come out of there. Similar effects are encountered in some labor days, festivities, parades, cultural events, temporal flea market's or sport final-score celebrations.

Sometimes things go out of control, but normally all of these events follow an authorized schedule. So transit authorities can update the data base daily to warn the drivers to avoid those areas, and simply the returning to normal conditions after the event.

Blocking streets is a popular way for protestors. Organizations like unions, peasants, students, political parties, organize an average of 3000 events every year freezing the traffic in Mexico City by blocking about 25,000 streets. [5].

Eventually, infrastructure needs maintenance. But not only pavements of road surface, but also many city services that run along the streets, like electricity, telephone, tap water and drain, contribute to this endless list, not to mention vehicle accidents. Some are incidentals, but many of them are scheduled and could be advised to drivers in order to take alternative routes.

Figure 6. Down town at Mexico City, one of the blocked streets by 15,000 protestors. ElInformador. 2013.

D. *weather*

Detours also occur because of weather events like snowfall and tsunami, but more often for the rain visibility difficulty. Regularly when the rain remains for a considerable time, water will block a few streets or road segments. As a result, geographical configurations may make inner-city lagoons and rivers not suitable for all vehicles to deal with. Recursively, after about an hour of continuous rain, those areas are flooded, which will remain 45 minutes until the last rain drop. Every local citizen is aware of these areas, but not all car drivers, and not to mention the tourists.

Other examples are tornados and hurricanes, which could cause significant damage to infrastructure. Figure 7 shows a low crossover at the San Marcos River, totally dry all year long, but commonly flooded on rainy days. During "Irene Hurricane" the river overflowed its banks for several days, destroying the pavement.

Figure 7 & 8. Victoria City´s," Av. Rodriguez Inurrigarro" Low crossover on San Marcos River on a normal day (7), and just after the "Irene" hurricane (8).

It took several months for this crossover to be re-opened to traffic, and this history is not exclusive for this town. After two years, New Orleans, USA, has similar consequences of the Katrina hurricane.

As the bad-designed infrastructure remains, situations like Figure 8 have been recurrent for a hundred times. Every year the government limits itself just to fix the damages, rather than build a bridge as it should have done a long time ago.

Cities continue to grow, not always in accordance with a plan. Temporary solutions look like the construction philosophy; it is very frequent to apply a just-for-now fix that at the end remains for decades.

Due to the lack of infrastructure maintenance, climatic change, economic restrictions and many other reasons, road networks are not expanded to keep pace with the demand.

According to the World Health Organization and the National Advice for the Prevention of Accidents, Mexico ranks the 7th in the number of vehicular accidents among countries. 17,000 people die and 50 million people get injured in Mexico's cities, and the number of death reaches 1.3 million per year in road accidents.

IV. GPS Complement

A. *Proposed smart phone application*

Today's mobile phones have reached high levels of computer power, mass storage capacity. Thanks to the cellular service carriers, an extensive area of the planet is covered with enough signal power to call or transfer information worldwide. (Figure 9).

Due to the long history on the evolution of these devices, there are countless numbers of cell phone platforms. But today, Android and Apple dominate the market, so it is relatively simple to offer this new application to a wide number of users. Currently, the application is under development, so a dummy is presented in its place

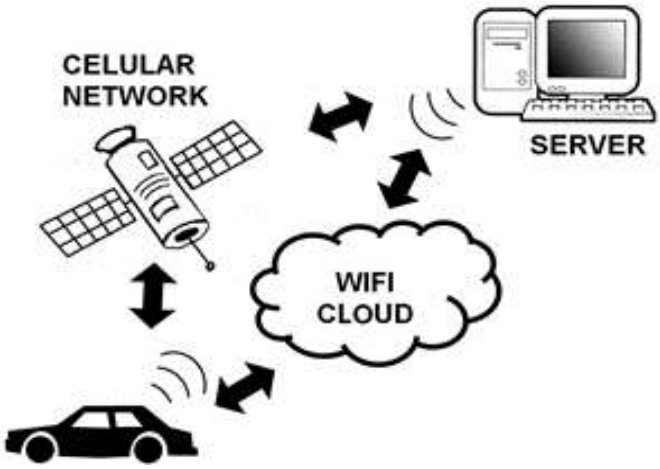

Figure 9. The communication between vehicle and server may use WIFI or cellular network to transfer voice or data information.

B. *Getting started*

Once the application is activated, the phone's GPS will locate current vehicle location. Then, it will download all the possible incidents in a hundred kilometer radius, ensuring enough information to navigate for at least one hour.

The database records with the minimum possible weight reduce data transfer, change the GPS position, incident type, severity (where apply), initial date-time, final date-time plus a comment on the incident. Figure 10 shows an example of a few incident identifications

C. *Standby mode*

During the time, it seems that there are no obstacles ahead. The application will run in the background, so the phone is able to run any other applications, or go to the rest mode to save battery.

Until a flagged GPS location approaches our current path, the phone will wake up and resume the application.

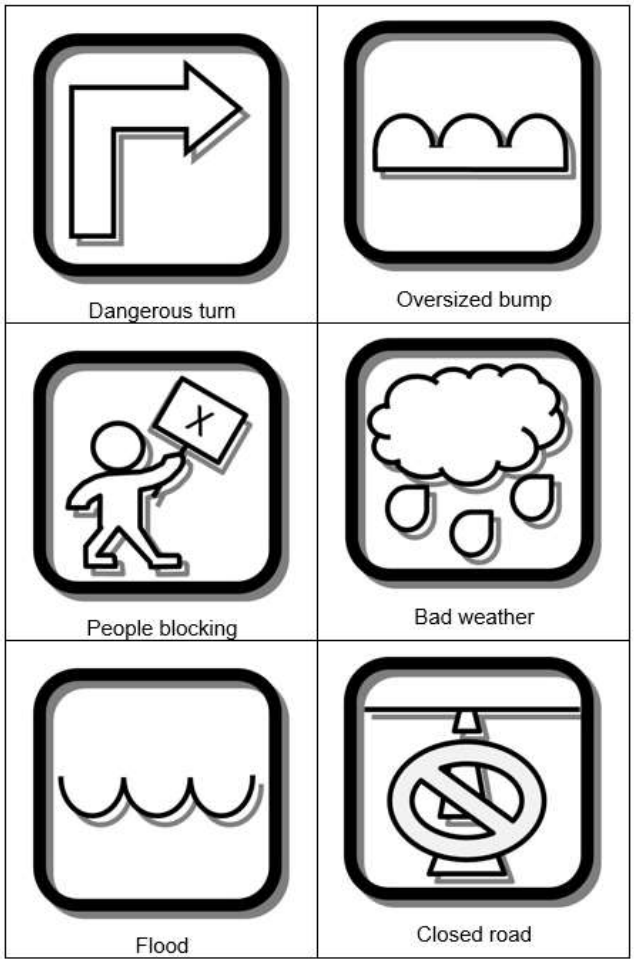

Figure 10. Warning signals examples.

D. *Situation approaching*

When an incident gets in our 500-meter horizon, the application will enter the active mode, to warn us of the type of incident and the distance to it.

Figure 11 shows the incident alert where blue blocks indicate non-incident area (normal), yellow blocks indicate preventive area (warning), and the red ones refer to the directly affected area (closed). The driver is given enough time to take evasive actions.

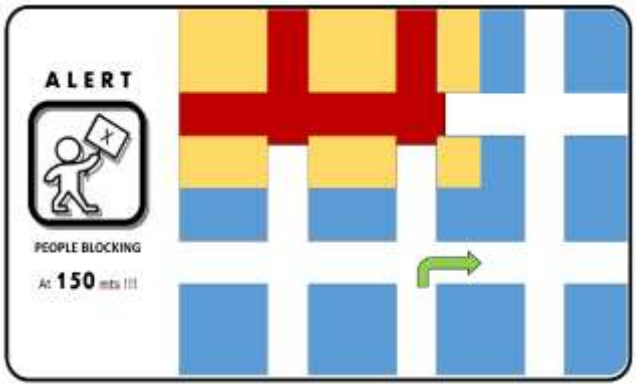

Figure 11. Application's print-screen. On a "People blocking ahead" alert.

Depending on the type of incident, more information could be useful like an event description or a transit authority recommendation, until the obstacle is overcome allowing the device to return to the standby mode. Until getting close to the next incident on the database, an update of the current weather condition on the surrounding area could be useful.

E. *Information update*

As can be observed, the system is not too complex, but it has its Aquiles heel. In order to develop the system, it is necessary to have veracity and accuracy on the information database.

Who will be responsible for keeping the information up-to-date properly in order to have only real world-wide records on the system? It is necessary to involve the Bureau of Tourism, Transit Authorities, and Civil Protection Organizations in every country and make them compromise, because getting funds to hire people all over the world seems like a non-feasible solution.

v. Conclusion

The automobile is an invention that will never terminate. For more than a century, cars have been everywhere. But each time technology evolves, and new devices and gizmos are invented, they try to get incorporated with the vehicles.

Radio, Television, Computers, improved engines, brakes, tires, materials, GPS, etc. and TI technologies are not different, and the smartphones are mature enough to open the door to a new set of commodities and advantages.

Better communication networks, more affordable service and equipment with tremendous advance in capabilities now make it possible to incorporate new concepts, like infotainment (hardware/software products and systems which provide information-based media content or programming also including entertainment content in an effort to enhance popularity with audiences and consumers). The Virtual Sailing Master is an effort to complement GPS navigation with local information that could reduce the risk of an accident, or at least reduce the disadvantage of getting caught in traffic.

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