Using Smartphones as an Instrument of Early Warning and Emergency Localization

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Abstract—This paper suggests using smartphones and community GPS application to make alerts more accurate and therefore positively influence the entire warning process. The paper is based on formerly published paper describing a Radio-HELP system. It summarizes existing methods and lists the advantages of proposed solution. The paper analyzes the advantages and disadvantages of each possible input, processing and output of the warning system.

Keywords—e-Call, warning, information, Radio-Help, WAZE.

I. INTRODUCTION

IN the previous paper [1], an improvement of current distribution of information in case of a traffic accident was proposed by our team. This paper endeavours to improve the already proposed solution. The extension is based on using a social GPS application which already works and helps drivers. But it works separately and independently on a NTIC (National Traffic Information Centre) [2] and this paper outlines how it could be implemented into the already described system.

II. CURRENTLY USED TELEMATIC METHODS

Currently the information about an accident or problem has to be reported by a driver or a witness of the accident. It means a phone call to the emergency line 112. This report is then transferred to the NTIC. From NTIC it is distributed via following information channels: variable information boards, RDS-TMC and voice relations on some radio stations. Disadvantages of those particular methods were in detail discussed in previous paper [1]. It can be briefly stated that the most important negative characteristics include the maintenance of variable information boards, the inability to work in bad weather conditions (heavy rain, blizzard, foggy weather and finally the delay which always appears. RDS-TMC and voice relations on radio stations can be missed by drivers.

There are some problems on the input as well. Today the information about a traffic accident is reported verbally to the emergency operations centers via mobile phones, either by those involved in accidents or their witnesses. However, this is associated with problems when attempting to better understand the given situation and determining adequate intervention (the exact position and direction of the vehicle,

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the scope of damage, elimination of repeated reports of the same accident, etc.). Speed of intervention is a key factor for its success, whereby any possible delays influence negatively the outcome of the entire rescue operation.

III. SHORT RANGE PLANNED METHOD (eCALL)

Project co-funded by the European Union aims to the creation of a system that enables automated reporting on accidents to the European-wide emergency line 112, including accurate information about its location. When the eCall device installed in a car detects an accident by means of sensors, it automatically sends a message to the nearest emergency centre, indicating the exact geographical location of the accident as well as other data. This system can be activated either manually by pressing a button on the dashboard by the vehicle passengers or automatically by the vehicle sensors triggered during an accident. After the system is activated, a connection with the nearest emergency call centre (PSAP) is established transmitting both sound and data flows. The sound connection enables vehicle passengers to communicate with professionally trained call operators while at the same time data channels are used to transmit data messages (MSD) to these operators. Each message contains 43 details about the accident, such as time, exact location, car identification, eCall system status (whether the eCall was activated manually or automatically) and information about possible service providers. Based on this information, the operator will liaise with the integrated emergency services to direct them to the exact accident location as well as provide them with an exact description of the accident's severity and the number of injured [3].

A manual use of the system can be useful when a traffic accident is witnessed (European Commission, 2010). eCall systems should be installed in all new cars, at the latest, by 2015 and possibly also installed in older cars [6].

Although this system brings a clear improvement of the current situation in terms of saving lives and providing quick health care during accidents, it does not provide a solution for distributing information about the accident to the drivers approaching the place of accident, i.e. who are potentially at danger. When using existing information channels, the acquired accident data could be made available in about 5-10 minutes via motorway information boards, RDS-TMC messaging and radio travel news. However, each of these distribution channels has specific limitations and based on current traffic density the above-mentioned reporting times are clearly insufficient. The next disadvantage is a fact, that according to the system specification, it cannot locate the car

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before the emergency message is activated. It means that after activating the message, the system starts searching for satellites therefore a delay is inevitable.

IV. System for Automated Forewarning of Vehicle Crashes

For better and particularly early distribution of warning information, a system called System for Automated Forewarning of Vehicle Crashes (the System) can provide remarkable help. This system has a data connection to the receiver systems-vehicle emergency call (e.g. eCall). The principle consists of full automation of generation and transmission of all relevant information about the accident to vehicles moving in its vicinity. The process of warning is initiated by the crashed vehicle, which will send information about the accident using eCall immediately after the collision happens together with the exact location of the accident. Information is received by the central office of the System which immediately generates data and / or voice information about the incident, including the positional code of the accident. Data will be sent via radio session and to car receivers as well [4].

System receivers (mobile phones, navigation devices) must be equipped with a positional code comparator of an accident positional data generated by the positioning system receiver. If the comparator evaluates that the position code of an accident coincides with position code of the receiver and vehicle movement will be evaluated as being directed to the scene of the accident, it will be forced to activate the data reception and / or voice session. In practice, we may be able to automatically inform road users according to their current position and direction of the danger which is coming, almost immediately.

The transmitted relation of Radio-Help uses positional codes for identifying areas of compulsory data reception i.e. where the broadcast is directed. The receiver in the area is maintained in standby mode and capture broadcast on fixed frequency. Then it compares its position according to GPS coordinates with areas included in the broadcast. If there is an agreement it activates forced broadcast reception session. After the broadcasting code ends receiver goes into standby mode again. Subscribers of Radio-Help that are outside the defined zone will not be disturbed by warning broadcast sessions.

The described process implies that it is possible to simultaneously transmit separate sessions to more areas. For the broadcast could be used longwave radio transmitters, which are currently in transition to shortwave broadcasts gradually lose its utility. In this case, would suffice to cover the whole CR only one central long wave transmitter.

More detailed information can be found in the previous paper [1] or under the working title RADIO-H (Radio Help) [5].

V. WAZE Method

WAZE is a free social GPS application featuring turn-by-turn navigation. WAZE is supported by Android, iPhone, Symbian, Windows Mobile. WAZE differs from traditional GPS navigation software as it is a community-driven application and learns from users' driving times to provide routing and real-time traffic updates. It gathers map data and other information from users who use the service. Additionally, people can report accidents, traffic jams, speed traps, police patrols. It can also update roads, landmarks, house numbers, etc.

WAZE is available for download and use anywhere in the world, but while some countries have a full basemap, other countries still require users to record the roads and edit the maps.

In addition to turn-by-turn voice navigation, real-time traffic, and other location-specific alerts, WAZE simultaneously sends anonymous information, including users' speed and location, back to its database to improve the service as a whole. This crowd sourcing allows the WAZE community to report navigation and mapping errors and traffic accidents simply by running the app while driving.

According to WAZE, there were 20 million users in June 2012, who were doubled within a 6 month period. Over 3.2 billion miles had been driven by WAZE users.

For the purpose of early warning we will deal only with the alerts. The routing and navigating is not important for this paper. WAZE can be used for warning in both cases – car accidents and traffic problems. It will inform other users the fastest way (compared to previously described methods). On the other hand, it has some disadvantages. A smartphone is necessary (OS: iPhone, Android, Windows Mobile or Blackberry) and a data plan is needed. But even with a data plan there are areas with no signal. In case of an accident there is a delay described in next chapter.

A WAZE user has to be disciplined and not distract other users by sending useless messages just for obtaining more points in the WAZE rankink system. During the report of an event a driver is distracted too.

WAZE does not get information only from its users but from NTIC as well. The reverse flow of information is not possible at the moment. Reports from drivers are verified by other drivers but WAZE is still not reliable information source for NTIC. Of course, even a WAZE user has a duty to report the accident on line 112. In this case the other WAZE users are informed two times.

The idea is to allow information from WAZE report flow into NTIC which would then deal with it like with information from any other source. It would ensure better awareness on the input. If the information is properly verified it could be processed by the Radio HELP system immediately without causing delay in NTIC. WAZE implementation would take effect in case of traffic problems that are not life-threatening. In those cases eCall is not activated and drivers are not obliged to inform NTIC about the problem.

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Fig. 1 Transmission and acquisition of information in the event of an accident with the use of eCall, Radio Help and WAZE (Author)

VI. Comparing Separate Segments of Each Method

We could divide the entire process into three parts: input, processing data and output. We can group them together and compare their advantages and disadvantages. In the following summary good data coverage for WAZE is assumed. The situations on input can be following:

- A participant or a witness will call emergency line (112) and announces the accident/traffic problem. Then NTIC will have to verify the message by sending police unit or fire department unit to check coordinates of the accident. A disadvantage of this method is an inevitable delay caused by the necessity of verification.

- eCall unit will automatically open a communication canal with an operator in the emergency centre (only in case of an accident). This method is the quickest one but it is switched on only in case of an accident and its implementation is not finished yet.

- WAZE user inputs information about an accident or a problem. After the accident is reported the information is forwarded to other users promptly. Besides disadvantages mentioned earlier there is a delay in special cases like a chain crash. There is no time to input the event so approaching drives have no chance to be informed. Even in usual (not chain) car accident the third driver will be warned (first driver crashes, second driver reports and third driver get a notice).

There is no absolute winner. The best choice consists of combination of all methods.

Data processing:

- NTIC – quick response due to the number of reports. But there is a human factor causing delays.

- Radio-HELP – automated processing, but it requests standard data format on input, which is possible only in case of eCall or WAZE input (or other automated solution).

- WAZE server – no delay, a verification is done by other drivers (WAZE units)

After comparing the fastest input (eCall) and fastest data

processing (Radio-HELP and WAZE), it was concluded that a combination of those two methods is not possible. eCall is an automatic system, but in current circumstances it needs a human worker to process information about an accident. On the contrary, Radio-Help and WAZE methods are processed automatically, but they need a human user to input the event.

Output – message for drivers:

- Output via standard methods (Variable information boards, RDS-TMC...) strongly depends on the quality and speed on previous two segments (input and data processing). There are exceptions (i.e. variable information boards in strong snow-fall) but in general this claim is correct.

- Radio-HELP receiver provides immediate information about the traffic problem. But at the moment it is only in a conceptual stage on which further work has to be done.

WAZE interface (smartphone) provides voice alert and it is quick as well especially for traffic problems without eCall activation.

VII. Summary

As a conclusion it can be seen that no one of the above methods is the best. However, it would be useful to incorporate WAZE into NTIC. The verification could be done via three times confirmed report from WAZE users. It would still be faster than sending there police or fire department unit to check it out. Although there are some obstacles, it should be quite simple to incorporate information from WAZE server into NTIC. The question is whether NTIC will be willing to adopt this solution. The broader spreading of smartphones and lower expenses for data plans could make things even easier.

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