SAVE ME Report Summary

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Periodic Report Summary - SAVE ME (System and actions for vehicles and transportation hubs to support disaster mitigation and evacuation)

Project context and objectives:

SAVE ME aimed to develop a system that detected disaster events in public transport terminals / vehicles and critical infrastructures (i.e. tunnels and bridges) and supports quick and optimal mass evacuation guidance, to save the lives of the general public and the rescuers, giving particular emphasis to the most vulnerable travellers. The focus group are all passengers, including older people, the disabled, children, and, in general the most vulnerable traveller groups. The project was successful in developing such a system and trialling the technology in two major pilot sites - the Colle Capretto Road Tunnel near Perugia, Italy, and Monument metro station, Newcastle upon Tyne, United Kingdom.

The SAVE ME main objectives were to:

1. identify the actual problems and needs of all travellers and stakeholders in dealing with various physical disaster or terrorism events;
2. devise specific use cases and application scenarios, covering all the project application areas (metro terminal, platform and vehicle and tunnel) for all types of emergencies considered (earthquake, fire and terrorist attack);
3. develop a holistic system architecture, that will allow inclusion of different elements and modules, as well as a common ontological architecture for hazards recognition, cause, severity and mitigation;
4. specify the systems and their modules for in-time detection and to develop the needed sensors (for detection, localisation, and situation awareness), as well as the appropriate telecommunication infrastructure;
5. investigate all users' behaviour (including emotions and stress) during panic situations, leading to the development of appropriate interfaces to inform the public, avoiding the cause of havoc and stress (including vulnerable travellers);
6. develop algorithms, based on intelligent agents, for personalisation of the information provision to the needs of each user (e.g. simple visual information for elderly users, or sound notification for visually-impaired users);
7. develop a decision support system (DSS), based upon dynamic and closed-loop simulation and modelling tools, with real-time data;
8. offer support to the infrastructure operators;
9. offer guidance to the rescue crew through personal digital assistants (PDAs);
10. offer guidance to the public through their mobile devices, as well as through public terminals and announcements;
11. develop training programmes (methodology, curricula and tools) for the infrastructure operators, the emergency units personnel and the general public, to optimise their performance during emergencies;
12. install and test the SAVE ME system in two pilot sites in order to evaluate its reliability, usability, usefulness, efficiency and market viability;
13. develop concise exploitation and dissemination plans for the successful and efficient adoption of SAVE ME products;
14. contribute to the standardisation activities that are being undertaken by national, European and international bodies, on infrastructure properties and evacuation aids.

Project results:

The following section summarises the main achievements of each work package (WP) in SAVE ME.

WP1: Problem definition, clustering and use cases

WP1 has been concluded in the first year of project work, thus a description of the work performed on the specific needs of the involved users and stakeholders, as well as the project detailed use cases, is provided in the first periodic report; relevant results are reported in D1.1 that has been submitted to the European Commission (EC).

WP2: System architecture specification and common ontological framework

The relevant work in WP2 was concluded during the second year of the project and reported in D2.1, submitted to the EC in the previous reporting period. The work performed and the achievements on the SAVE ME system architecture

and the ontological framework are reported in the second year periodic report.

WP3: Algorithms, interfaces and intelligent agents

WP3 work was concluded during the second year. All the work that has been performed in WP3 on the disaster mitigation strategy, interfaces and personalised guidance solution is reported in D3.1 and D3.2. Information on the achievements can be found in the second year periodic report.

WP4: Detection systems

WP4 work is depicted in the three relevant deliverables, i.e. D4.1, D4.2 and D4.3 and was concluded on the second project year. Thus, relevant achievements on the environmental sensors module, the localisation sensors module and the telecommunication network and can be found in the second year periodic report.

WP5: DSS

During the reporting period, efforts have been put on the evaluation of the decision support algorithms developed in the previous period. D5.2 (submitted in the previous reporting period) has been revised accordingly in order to include evaluation results for the implemented evacuation modules for vulnerable travellers and the rescue teams.

The SAVE ME decision support module has been further enhanced and the logging functionalities have been further enriched so both performance and the reliability of the DSS and telecom network can be assessed. Moreover, in collaboration with the pilot site partners, CERTH / ITI defined the final xml schemas for the monitoring sites and several bugs were found on the multi-agent framework and have been fixed in advance. In close collaboration with WP7, the necessary functionality has been implemented in the DSS towards providing the information needed by the virtual reality (VR) training platform for visualising results during training.

It was identified that an original multi-threaded approach was too fast for the SAVE ME communications handlers and a single threaded approach was implemented instead. The final communications code was optimised resulting in an end-to-end computational exchange with the DSS of under 0.7 seconds with all logging enabled. D5.1 was subsequently revisited to take account of the extensions listed above and resubmitted.

Finally, in relation to the visualisation component (VR platform), two custom code items were provided - a custom virtual world viewer and the reuse and extension of an internal Simudyne project to allow the simulation module to spawn and control the traveller avatars representing the community being protected by SAVE ME in the near real time.

WP6: Emergency support measures

Although WP6 work ended at the end of the second project year, several improvements and updates continued in the third year in several parts of the development. This included the redesign of several graphical elements and other changes as a result of user testing done with prototypes (A8.2, see D8.2 for detailed results), the OpS-UI was transferred from the desktop personal computer (PC) Hypertext markup language (HTML) platform to the iPad. Also, progress has been made to the optimisation of the design and implementation of both main components of the RTG module: the RTS server and the RT mobile application. The development of the user interface has been completed, then passed through the process of testing with real users and it has been dedicated time in order to design and implement the improvements resulted from users feedback. Maps of both test sites have also been integrated (see final D6.2.).

Regarding guidance systems, the individualistic guidance applications have been developed and tested across three mobile phone platforms: Symbian, Android and iPhone OS. Two innovative systems were designed and implemented: the lighting path incorporated in the wireless sensor network (WSN) at the tunnel pilot site, and a system of displayed arrows indicated the escape path for the more complex situation of the metro station. During the final year, both implementations were completed and tested during the trials. All the latest improvements are in the updated D6.3.

WP7: Training measures

During the reporting period, efforts have been made by partners to finalise the training scenarios for the operators as well as to conclude on the design and development of the corresponding VR platform. The implementation of the VR platform has been finalised, focusing on both the scenarios preparation and the integration with the DSS module (WP5). Four different but complementary scenarios have been defined, each accompanied with an enriched set of exercises.

Regarding the VR platform, the final version of the SAVE ME 3D VR viewer allows end-users to navigate the virtual world. The aim of the emergency team training is to provide the SAVE ME emergency teams with adequate information through training curricula and content, about the use of the SAVE ME system in real cases. The training curriculum has been defined in D7.1, such as systems and components description, technical characteristics, PDA applications, system limitations. Also, specific exercises and scenarios are defined.

The peculiarity of general public training is that there are few or no possibilities to train people on how to behave or on how to reduce the response time in case of emergency. In order to achieve the project aims, the available tools and

media have been evaluated for each site, in order to reach the widest range of travellers. Moreover, for each category of traveller, the most suitable way to communicate with the travellers has been identified, and then correlated with the available communication means.

At the beginning of the project, a pilot site (and the corresponding case study) for each category was identified:

(a) Gotthard tunnel for the road transport; and
(b) the Monument metro station of Newcastle for rail transport.

Therefore, a thorough analysis of both sites has been conducted in order to identify the most suitable means and tools already available in each site. However, the pilot site for the road transport has changed to the Colle Capretto tunnel in Italy and the analysis carried out for the Gotthard tunnel have been reviewed according to the characteristics of the new site, and the case study was adapted accordingly. For the individual guidance application (on the mobile phone) the focus has been on the installation instructions on the mobile phone, for all the supported platforms (Symbian, Android, iPhone). All the above work and achievements are reported in D7.1 which has been submitted to the EC.

WP8: Pilot testing

The first iteration of D8.1 (pilot plans) was prepared and submitted at the end of M15. This deliverable continued to be updated and revised as necessary, to take into account the various technical developments arising from continuing work in WP4 and WP5, as well as incorporating the needs emanating from the pilots. Laboratory testing of the individual components of the SAVE ME system continued into year 3 across various locations with individual project partners leading these tests.

Year 3 saw a significant alteration to the planning and execution of WP8. The withdrawal of GST as a pilot site within the project in late 2011 coupled with the subsequent move of pilot site to the Colle Capretto road tunnel required significant revisions to the D8.1 pilots plans, as well as revising the overall project's logistics, assigning and transferring GST's outstanding resources to CNVVF, IES, SimudyneE and MIZAR to enable the new pilot site to be incorporated into existing plans and subsequent revisions to the proposed scenarios used for testing the SAVE ME system. In light of the complexities involved with this shift in pilot sites, D8.1 was kept open until it was certain that the Colle Capretto road tunnel was able to accommodate the needs of SAVE ME, and following detail negotiation and planning for the scenarios, a final version of D8.1 was delivered in M32 (May 2012). Thankfully, due to an immense amount of additional work and collaborative efforts from many partners, all pilot tests at Monument metro station and the Colle Capretto road tunnel were successfully conducted in M32-33 (May / June 2012), in line with the relevant WP8 milestone as proposed in the description of work.

During the project, nine lab tests and two real pilots have been conducted. The former were meant to test and evaluate the single elements of the system, while the latter were planned to test the overall system. The consolidated tests results and feedback by the tests participants are reported in detail in D8.2, which has been submitted.

WP9: Dissemination, guidelines, standards and exploitation

During the 3rd year of the project, the final project workshop was organised on 27 June 2012 in Newcastle (United Kingdom). During a full day of sessions, discussions and demonstrations of the project outcomes were unveiled, including achievements from the two pilot tests successfully carried out in Italy and in the United Kingdom. In total, 52 people attended the workshop, 71 % of which were external to SAVE ME consortium. Dissemination material and tools were prepared / updated to support the final event organisation. The fourth and final issue of the bulletin was published and distributed online at M36.

The website (see http://www.save-me.eu online) and the internal file transfer protocol (FTP) area (for files exchange among the consortium) have been continuously updated to include relevant news and documents related to the project. The project video is ready and available on the project website. Finally, four new publications were made in the third year, reaching a total number of eight publications for the project. In addition, a publication is sent to an international conference that will take place in 2013 (acceptance results are pending).

An international market research exercise was successfully carried out covering many different angles of the potential markets for SAVE ME. A detailed breakdown of the approach and results can be found in D9.6, the main findings of this particular exercise are that the SAVE ME solution does not have any correlation to existing commercial system and the vast majority of survey respondents felt that SAVE ME was a generally beneficial capability with 61 % of respondents stating that SAVE ME would be beneficial to their business.

Following on from the market research, two separate evaluations were made. The first was a cost-benefit analysis (CBA), the full process of which is given in D9.6, but depending on the degree of effectiveness and percentage of penetration of SAVE ME within the travelling public, a positive CBR was returned for both pilot sites. After the CBA, a cost-effectiveness analysis (CEA) was conducted utilising the analytical hierarchy process addressing seven key operational and societal objectives across six of the key SAVE ME components. Further details and results can also be found in D9.6, but the key finding from this CEA exercise was that the operator support and rescuer guidance modules were deemed to be the most effective whereas the individual guidance module (personalised mobile devices) was deemed to be the least effective.

Finally, more than 20 guidelines for the implementation of the SAVE ME system were collated along with recommended standardisation actions for WSN localisation, modelling and simulation, symbologies / icon design, tunnel directives, ontologies and training and certification curricula. These guidelines and standardisation actions are of critical importance in the provision of a safety system for the travelling public, especially if SAVE ME is to be adopted across multiple sites and have been disseminated for consideration in key areas.

WP10: Project management

The project management proceeded throughout year 3 without any significant problems despite the withdrawal of two partners plus a move from GST to Colle Capretto for the final pilot trials and tests. Overall management has come from UNEW, including the liaison with the project officer at the European Union (EU), submission of deliverables at the appropriate point and generally ensuring all partners are working towards a common objective. In year 3, the majority of the project management duties related to the transfer of resource to various partners to account for the partial withdrawal of GST and the full withdrawal of COAT from the project.

The targeted technical and scientific project aims outlined in the technical annex have been accomplished, for which the technical management has played a significant role. Technical management has come from CERTH / HIT, with an active function in all technical decisions and solutions.

Finally, the quality management set up a procedure through which all the project outcomes undergo a quality review. This procedure is reported in detail in the quality assurance handbook (D10.1), which has been submitted in the first year of the project. Thus, all deliverables that have been submitted so far have been peer reviewed and modified according to the reviewers' comments, before being submitted to the EC.

In total, there have been eleven project plenary meetings over the project's lifetime in Newcastle, Thessaloniki, Roma and Mykonos during year 1; Luzern, Luxembourg, and Santorini in year 2; Lanzarote, Roma / Montelibretti / Perugia, Newcastle and Chalkidiki in year 3. For each meeting the agenda and the minutes are prepared by the coordination team. Additional ad-hoc meetings specifically for technical development were held in Roma and in Newcastle, mainly for the needs of the pilot preparation.

D10.1 and 10.2 have been submitted in the first year. Also, D10.3 which is the mid-term periodic report (18-month period) was submitted on time. During the last project period, D10.4 and D10.5 have been also submitted on time.

Potential impact:

The expected project results are:

- definition of the main needs of the target group, the state of art in transport related emergency support systems and detailed use cases for the development of the SAVE ME platform, taking into consideration the target group needs and the potential to achieve maximum impact on European and national levels;
- SAVE ME ontological structure; functional, logical, physical, communication and overall system architecture and specifications of SAVE ME and its components;
- manuscript with guidance rules for the public, according to user behaviour, type, event type or other key parameters;
- optimal and adaptable user interface, elements (visual, acoustic, haptic);
- intelligent agents module, for the overall management and personalisation of SAVE ME applications;
- overall disaster mitigation strategy of SAVE ME;
- selection of the appropriate sensors and technologies for SAVE ME WSN;
- telecommunication network for SAVE ME operability;
- development of SAVE ME detection subsystem, able to transmit to the operator's centre all key info on the disaster as well as info on the presence and movements of the people within it;
- an enhanced simulation model, taking into account the behavioural changes of older, disabled, children and re-calculating prediction results, based on real-time data;
- a DSS that supervises all disaster mitigation actions;
- support modules for operators, rescuers, and travellers at risk (both personalised and generic);
- training sets (curricula, content, tools) for the infrastructure operator, rescuers and users, covering also the vulnerable persons;
- development of a common approach for cross-comparison of sites;
- SAVE ME system installed and fully assessed in all sites;
- reliability, usability, usefulness, user acceptance and viability analysis of SAVE ME system module and training courses;
- high project profile to relevant stakeholders;
- viable marketing, business and exploitation plans for all potential project products;
- input to standardisation bodies and key stakeholders;
- ethic handbook and strategy of the project, guiding all its activities and developments.

All the above targets have been reached during the project lifetime.

Potential impact and use

Economic impact

Economic damages from natural disasters are enormous. In transport, economic damages are typically of several million Euro per disaster (from EUR 1.2 million for Gotthard in 1997 fire, to EUR 155 million in Mont Blanc incident in 1999). After each catastrophe to a transportation infrastructure, hub or vehicle, measures take place that have an equally high cost. To that, we should add the very big cost of human life lost (in fact priceless, but conservatively being estimated to EUR 1 - 2 million per person by various European countries). Obviously, it is much better to add much more cost efficient to act proactively. To invest to a rather low cost technology, such as SAVE ME, in order to protect infrastructures of several millions of Euro and moreover hundreds of human lives within them can only be an economically justified investment.

In addition, economic benefit is expected to be further created by:

- more travellers' attraction: Innovative solutions that could deal with issues of high importance such as human integrity and safety will primarily be acceptable and obviously expected to attract developers' and travellers' interest;
- creation of jobs and wealth the proposed new services and products for disaster mitigation are expected to invite for new investments in several transportation infrastructures on advanced technologies and systems, thus creating gains for the European Industry and especially SMEs-installers, operators and maintainers of these infrastructures.

Social benefits from the optimum crisis management

SAVE ME system provides critical detection as well as critical response, based on the detection and communication system. Through its decision support system, SAVE ME increases the level of safety and security of the whole transport system and its components as it provides:

- operators' / drivers' / rescue teams' training;
- construction guidelines for vehicle and station;
- more accurate and efficient response by emergency operators;
- guidance of emergency teams;
- guidance of individuals (through mobile devices), and enhances the positive interactions between operators/infrastructure, in order to decrease the level of human error and increase the safety performance of the infrastructure.

Major public benefits are expected as the proposed solution will primarily attract travellers to transit and will offer them efficient solutions for a calm and effective management in critical events. Travellers' future response to new physical catastrophes or - even more - terrorist attacks on the transport network causing huge human losses is difficult to estimate. Problematic psychological behaviour basically boils down to either an exaggerated response or denial. A blanket refusal to take public transport could be what experts call maladaptive behaviour. On the other hand, in a place when a specific warning is issued about a threat in a particular place and someone went there anyway, his / her behaviour would be equally maladaptive. There are parameters of normal behaviour, within which people weigh up the information they are given and calculate the immediacy of the threat to their personal safety.

Ultimately, the important thing is to remain in control of a situation - because terrorism hinges on its ability to destroy people's trust in the predictability of their environment. While terrorism first and foremost claims lives, its effect is also based on a manipulation of people's fears. They don't know when or where the next attack will come, and they do not know how to protect themselves against it.

They are rendered powerless, in a situation which they cannot control. This is hard to accept, because people are used to being in control of their lives. What terrorism does is to demonstrate that they actually have no control over what happens - their lives are in someone else's hands.

However, public transportation is critical for the transportation system of each country and is essential to the economic and social quality of life of the citizens. So systems and technologies have to increase the level of protection of the transport systems users giving apparently special attention to the most vulnerable ones. SAVE ME proposed solution, based on the physiological aspect in emergencies or disaster events, addresses directly the core of the problem: humans' instinctive reactions in panic situations. Another important issue is that a large percentage of users are facing various mobility difficulties and apparently is expected to be in an extremely anguished situation in disaster events.

Project website: http://www.save-me.eu/

Related information

Documents and Publications	Periodic Report - SAVE ME (System and actions for vehicles and transportation hubs to support disaster mitigation and evacuation)

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