FROG

FUN ROBOTIC
OUTDOOR GUIDE

Deliverable: D6.1

Dissemination Activities Report

Consortium

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PROGRAMME

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Table of Contents

1. Summary

Dissemination and exploitation of the project results was set as one important point of the FROG project. This report documents the effort developed by the Consortium to address this task.

The document starts with a summary of FROG's developed scientific knowledge and exploitable results. These are given in sections 2 and 3, respectively.

As well as the external communication, the internal communication was also very important for the project to succeed. The goals could only be achieved with the FROG partners working closely together and combining their knowledge on the various different disciplines. The Consortium made use of effective tools and strategies for internal communication. This is summarized in Section 4.

The main objective of dissemination and exploitation is to realize effective communication to the scientific community, companies in robotics, end users and to share with them the project results and ideas. This is presented in Section 5.

The report ends, in Section 6, by defining a path for the future exploitation of the project outcomes.

2. Scientific Knowledge

The scientific outcome of the FROG project can be summarized by the produced deliverables which were all defined as public and are published on the project website: https://www.frogrobot.eu/wordpress/publications-and-deliverables-2/.

The produced deliverables along the project duration are summarized in Table 2.1.

Del. no.	Deliverable Title	Nature	Dissemination level
D1.1	Functional requirements, interaction and constraints	R	PU
D1.2	Initial Robot platform	R	PU
D1.3	Customised mobile platform	P	PU
D1.4	Platform user and developer manual	R	PU
D1.4 update	Platform user and developer manual	R	PU
D2.1	Robot 6DOF precise localization component	O	PU
D2.2	Path planning and execution component for efficient and human-aware navigation	O	PU
D2.3	Sensor data and Multimedia database with the virtual content for AR application	O	PU
D2.3 revised	Sensor data and Multimedia database with the virtual content for AR application	O	PU
D2.4	AR Robot Application component	O	PU
D2.4 revised	AR Robot Application component	O	PU
D3.1	Final feature extraction component	D	PU
D3.2	Demonstrator of human affective signals analyzer	D	PU
D3.3	Person guidance navigation component	D	PU
D4.1	Identification, evaluation and design of guide robot personality and behaviours:		
part a	Engaging Personalities and Behaviours	R	PU
part b	Contextual Analysis of Effective (non-verbal) Human Tour Guide Behaviour	R	PU
part c	Design Guidelines for Effective Robot Guide Behaviour	R	PU
part d	Design Guidelines for Robot Personality	R	PU

D4.2	Demonstrator of human conversational signals analyser	D	PU
D4.3	Library of behaviours and demonstrator of adaptive robot behaviour system	D	PU
D5.1	Iterative Integration and evaluation report	R	PU
D5.1 revised	Iterative Integration and evaluation report	R	PU
D5.2	Simulation environment for FROG AR	P	PU
D5.3	FROG Robot integrated demonstrator	D	PU
D5.4	Demonstrator Evaluation Report	R	PU
D6.1	Dissemination activities report	R	PU
D6.2	Data sets for Benchmarking	R	PU

Table 2.1. Project FROG list of deliverables.

The list of deliverables summarized in Table 2.1 can be of the following nature: Report (R), Demonstrator (D), Prototype (P) or Other (O). As can be seen they are all set as Public (PU).

3. Exploitable Outcomes

This section describes the project's main outcomes to be exploited by the FROG project partners. These outcomes are the result of work undertaken individually or in partnership along the project duration. The Consortium identifies the following exploitable outcomes:

- standalone robot platform;
- robot 6DOF precise localization component;
- person tracking at larger distances component;
- human affective signals analyzer component;
- navigation in populated environments component;
- human-robot interaction strategies;
- integrated FROG solution;
- applied knowledge on the targeted user group.

A summary of each of these components is now presented.

3.1. Standalone Robot Platform

In FROG, the standalone robot platform is the hardware component; i.e., the robot with its sensors, actuators, electronics and mechanics (see Figure 1).

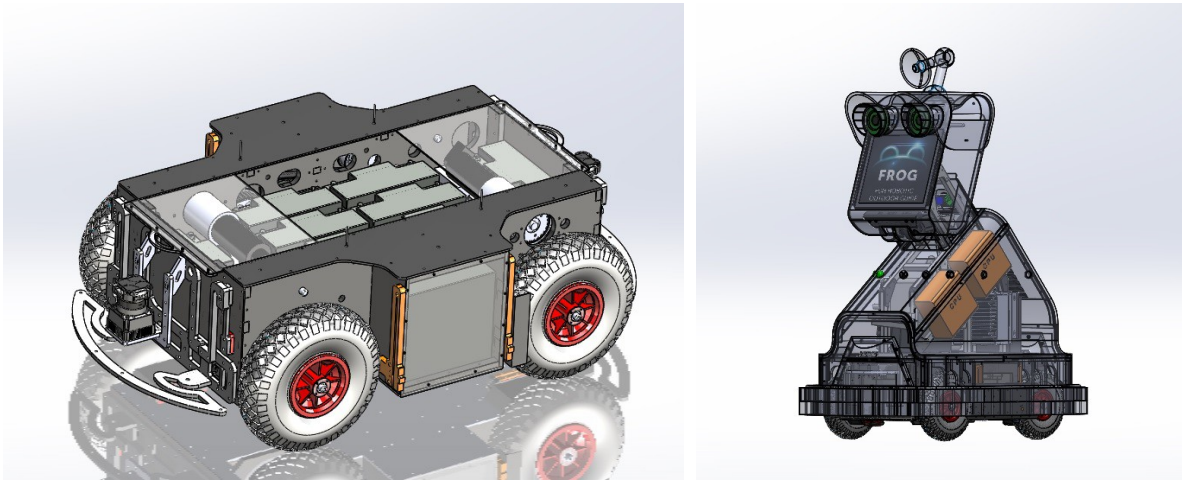

Figure 1. Standalone robot platform. Left: platform base. Right: full platform.

3.2. Robot 6DOF Precise Localization Component

This component is a map-based localization module (see Figure 2). It provides precise-enough six-degree of freedom localization for navigation and augmented reality (AR) presentation purposes. The development was effected with two main localization issues in mind: accuracy for the AR application, and robustness in order to achieve long-term autonomy of the robot.

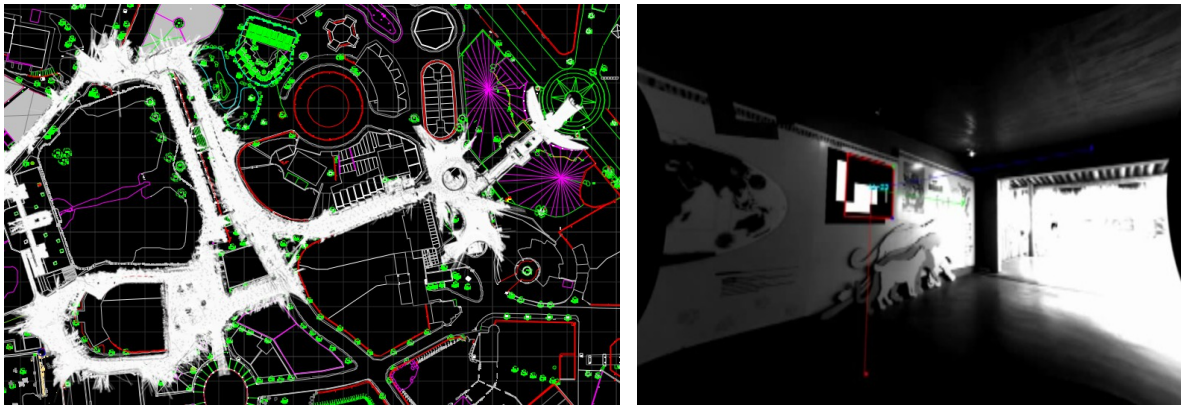

Figure 2. Localization module.

3.3. Person Tracking at Larger Distances Component

This stereo-based person detection software component runs in near real-time at about 10 Hz and it is responsible for locating persons in groups in outdoor spaces, with an estimate of person body facing direction (see Figure 3). It handles dynamic backgrounds with significant amounts of clutter and numbers of occlusions and changing illumination conditions.

Figure 3. Person detection and body orientation estimation based on stereo cameras detection.

3.4. Human Affective Signals Analyser Component

This component, depicted in Figure 4, uses visual methods to detect human affective states, positive and negative reactions to the robot and their overall level of interest in the current interaction with the

robot. Output from this module includes an estimation of valence and arousal of the person being tracked, and flags specifying whether the person is smiling, or nodding or shaking their head, and several coordinates and positioning values.

Figure 4. Human affective signals analyser component.

3.5. Navigation in Populated Environments Component

This navigation stack is able to perform autonomous navigation in given scenarios with socially acceptable, efficient path planning for robot missions in crowded sites (see Figure 5). The person tracking at larger distances component is integrated into this component so that the navigation controller can take the positions of surrounding persons into account and move in a human-aware fashion.

Figure 5. Navigating in a crowded scenario.

3.6. Human-Robot Interaction Strategies

Developed human-robot interaction strategies (see the example depicted in Figure 6), resulting from the study of human tour guide strategies and behaviours – especially those depending on visual feedback - and also from the feedback of the users on the different evaluation tests.

Figure 6. Discovering the environment with the FROG.

3.7. Integrated FROG Solution

The integrated FROG system is the result of the integration of all the components developed in the scope of the project. This includes the standalone robot platform with its autonomous capabilities for navigation, perception and interaction (see Figure 7).

3.8. Applied Knowledge on the Targeted User Group

FROG proposed the development of a guide robot with a winning personality and behaviours to engage tourists in a fun exploration of outdoor attractions. In order to successfully address this target group, several tasks of the project aimed at increasing the consortium's knowledge on this group. Clearly the knowledge of the user group targeted by FROG to be used in the definition of the project products and services can be viewed as another exploitable project result. Indeed, it is not far-fetched to believe that this knowledge could be applied in other areas besides the FROG project.

Furthermore, this applied knowledge can be viewed as a commercially exploitable project result. The commercialization of consulting services based on the knowledge of the user group acquired during the project can be regarded as an exploitation possibility.

Figure 7. The integrated FROG solution.

4. Internal Communication Strategy

This section lists some measures that were adopted to ease the communication and work cooperation between the partners.

4.1. Consortium Agreement

The formal set of rules and guidelines are agreed in a Consortium Agreement (following the DESCA model for FP7 projects) between the FROG project partners.

4.2. Email List

For easy communication an email list has been created to email to all the team members: FROG-MB@LISTS.UTWENTE.NL.

4.3. Webpage

The project webpage, explained with more detail in Section 5.6, was set as blog format with all activities in and around the project. The webpage address is the following: http://www.frogrobot.eu/

4.4. Teleconferences

During the three years of the project there were regular teleconference meetings with the partners. These teleconference meetings were set on phone or through *skype* and usually were preceded by a *doodle* poll to set up the most adequate day/time for all. Some teleconferences involved all the partners, some other were one-to-one meetings.

4.5. Sharing Information

The Consortium was regularly sharing relevant information through cloud services, e.g., dropbox. These information included reports, meetings photos, movies and data sets.

4.6. Editing Documents

Most of the deliverables resulting from the contribution from different partners were made through cloud shared resources, e.g., google docs.

4.7. Integration Weeks

During the three years of the project there were ten Integration/Data Collection meetings. Four meetings were held at the Lisbon Zoo and six others at the Royal Alcázar in Seville. The partners made use of these meetings to integrate all the developed hardware and software. Furthermore, these meetings were an ideal moment for discussing the progress and plans, and deciding on the next steps.

5. Dissemination Strategy

Dissemination of the acquired knowledge and achievements is an important element of a project. This section presents the methodologies that were followed to disseminated the project results to the scientific community, industry and general public.

5.1. Journals Publications

The list of publications in journals, targeting the scientific community, is now presented.

2014

- I. Marras, Tzimiropoulos, S. Zafeiriou & M. Pantic, **Online Learning and Fusion of Orientation Appearance Models for Robust Rigid Object Tracking.** In: *Elsevier Image and Vision Computing, (in press).*
- Javier Pérez-Lara, Fernando Caballero, and Luis Merino, **Enhanced Monte Carlo Localization with Visual Place Recognition for Robust Robot Localization.** In: *Journal of Intelligent and Robotics Systems, (submitted).*
- F. Flohr, M. Dumitru-Guzu, J. P. F. Kooij and D. M. Gavrila, **A probabilistic framework for joint pedestrian head and body orientation estimation.** In: *IEEE Trans. on Intelligent Transportation Systems, (under review – minor revision).*

2013

- Jie Shen and Maja Pantic, **HCI^2 Framework: A Software Framework for Multimodal Human-Computer Interaction Systems.** In: *IEEE Transactions on Systems, Man, and Cybernetics–Part B (IEEE TSMC-B)*, 2013 (accepted for publication).

2012

- L. Merino, A. Gilbert, J. Capitan, R.Bowden, J. Illingworth, and A. Ollero, **Data Fusion in Ubiquitous Networked Robot Systems for Urban Services.** In: *Annals of Telecommunications,* Special Issue Ubiquitous Robots, 67, 2012. *Impact factor 2011 – 0.633*
- G. Tzimiropoulos, S. Zafeiriou and M. Pantic, **Subspace Learning from Image Gradient Orientations.** In: *IEEE Transactions onPattern Analysis and Machine Intelligence*, vol. 34, no. 12, pp. 2454-2466, DOI: 10.1109/TPAMI.2012.40. *Impact factor 2011 – 4.908*
- S. Liwicki, S. Zafeiriou, G. Tzimiropoulos and M. Pantic, **Efficient Online Subspace Learning with an Indefinite Kernel for Visual Tracking and Recognition.** In: *IEEE Transactions on Neural Networks and Learning Systems*, vol. 23, no. 10, pp. 1624-1636, October 2012. *Impact factor 2011 – 2.952*
- S. Liwicki, G. Tzimiropoulos, S. Zafeiriou and M. Pantic, **Euler Principal Component Analysis,** In: *International Journal of Computer Vision,* 2012, DOI: 10.1007/s11263-012-0558-z. *Impact factor 2011 – 3.741*

5.2. Conference Publications

The list of publications in conferences, targeting the scientific community, is now presented. Papers were presented at the following conferences: Robot'13, ACM MM'13, ICCV'13, IROS'13, ICSR'13, ISR'14, IROS'14, ICRA'14, RSS'14, IEEE ICARSc'14, ICINCO'14, RO-MAN'14, ECCV'14, HRI'14, SIGCHI'14.

UPO received a best paper award at IEEE ICARSC. UT was nominated for a best late breaking report award at HRI 2014.

There are still plans for a consortium project publication with the achievements of the project.

2014

- Javier Pérez-Lara, Fernando Caballero, and Luis Merino, **Integration of Monte Carlo Localization and Place Recognition for Reliable Long-Term Robot Localization,** In: *Proceedings of the IEEE International Conference on Autonomous Robot Systems and Competitions (IEEE ICARSC),* 2014. Best Paper Award

- Rafael Ramón-Vigo, Javier Pérez-Lara, Fernando Caballero, and Luis Merino, Navigating among people in crowded environment: **Datasets for localization and human robot interaction,** In: *3rd Workshop on Robots in Clutter: Perception and Interaction in Clutter (IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS'14),* 2014.

- Javier Pérez-Lara, Fernando Caballero, and Luis Merino, **Long-term Ground Robot Localization Architecture for Mixed Indoor-Outdoor Scenarios,** *In: Proceedings of the International Symposium on Robotics, ISR,* 2014.

- Rafael Ramón-Vigo, Noé Pérez-Higueras, Fernando Caballero, and Luis Merino, **Transferring human navigation behaviors into a robot local planner,** In: *Proceedings of the IEEE International Symposium on Robot and Human Interactive Communication, RO-MAN,* 2014.

- Noé Pérez-Higueras Rafael Ramón-Vigo, Fernando Caballero and Luis Merino, **Robot local navigation with learned social cost functions,** In: *Proceedings of the 11th International Conference on Informatics in Control, Automation and Robotics (ICINCO 2014).*

- L. Zafeiriou, E. Antonakos, S. Zafeiriou and M. Pantic, **Joint Unsupervised Face Alignment and Behaviour Analysis,** In: *Proceedings of the 13th European Conference on Computer Vision (ECCV 2014).* Zurich, Switzerland, pp. 167 - 183, September 2014.

- Karreman, D., Utama, L., Joosse, M., Lohse, M., van Dijk, B., & Evers, V. , **Robot etiquette: how to approach a pair of people?** In: *Proceedings of the 2014 ACM/IEEE International Conference on Human-Robot Interaction* (HRI 2014) (pp. 196-197). ACM. Best Late Breaking Report Nominee. Bielefeld, March 2014.

- Karreman. D.E., Ludden, G.D.S., (van Dijk, E.M.A.G.), Evers, V., **DREAM: a Thin-Slice Approach to Annotate and Analyze HRI In-The-Wild Data,** In: *Human-Robot Interaction (HRI), 2015 10th ACM/IEEE International Conference on*. IEEE, 2015. *(submitted).*

- Karreman. D.E., Ludden, G.D.S., Evers, V., **Beyond R2D2: Exploring approaches to design behavior for non-humanoid robots,** In: *Proceedings of the 33th annual ACM conference on Human factors in computing systems*. ACM, 2015. *(submitted).*

2013

- I. Marras, J.A. Medina, G. Tzimiropoulos, S. Zafeiriou & M. Pantic, **Online Learning and Fusion of Orientation Appearance Models for Robust Rigid Object Tracking,** In: *Proceedings of the IEEE 10th International Conference on Automatic Face & Gesture Recognition (FG 2013),* April 2013.

- J. Ballesteros, L. Merino, M. A. Trujillo, A. Viguria, and A. Ollero, **Improving the Efficiency of Online POMDPs by using Belief Similarity Measures,** In: *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA 2013)*, pp. 1784-1790, ISBN: 978-1-4673-5642-8, 2013.

- D.E. Karreman, G.U. Sepúlveda Bradford, E.M.A.G. van Dijk, M. Lohse, and V. Evers, **What happens when a robot favors someone? How a tour guide robot uses gaze behavior to address multiple persons while storytelling about art,** In: *Proceedings of the 8th ACM/IEEE International Conference on Human-Robot Interaction (HRI 2013)*, IEEE Robotics and Automation Society, USA, pp. 157-158, 2013.

- D.E. Karreman, G.U. Sepúlveda Bradford, E.M.A.G. van Dijk, M. Lohse and V. Evers, **Picking Favorites: The Influence of Robot Eye-Gaze on Interactions with Multiple Users,** In: *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2013),* IEEE Robotics and Automation Society, USA, pp. 123-128, November 3-7, 2013, Tokyo, Japan.

- D.E. Karreman, E.M.A.G. Van Dijk, and V. Evers, **Position paper : design of robot specific behavior for tour guide robots,** In: P*roceedings of Embodied Communication of Goals and Intentions, workshop at International Conference on Social Robotics (ICSR 2013)*, 2013.

- Mihalis A. Nicolaou, Stefanos Zafeiriou and Maja Pantic, **Correlated-Spaces Regression for Learning Continuous Emotion Dimensions,** In: *Proceedings of 21st ACM International Conference on Multimedia (ACM MM'13),* 2013 – 978-1-4503-2404-5, pp. 773-776, Oct. 2013.

- Yannis Panagakis, Mihalis A. Nicolaou, Stefanos Zafeiriou and Maja Pantic, **Robust Canonical Time Warping for the Alignment of Grossly Corrupted Sequences,** In: *Proceedings of the 26th IEEE Conference on Computer Vision and Pattern Recognition (CVPR 2013),* Portland, Oregon, USA, pp. 540-547, June 2013.

- Lazaros Zafeiriou, Mihalis A. Nicolaou, Stefanos Zafeiriou, Symeon Nikitidis and Maja Pantic, **Learning Slow Features for Behaviour Analysis,** In: *Proceedings of the IEEE International Conference on Computer Vision (ICCV 2013),* 2013.

- G. Tzimiropoulos and M. Pantic, **Optimization problems for fast AAM fitting in-the-wild,** In: *Proceedings of the IEEE International Conference on Computer Vision (ICCV 2013),* 2013.

- L. Merino, Joaquin Ballesteros, Noe Perez-Higueras, Rafael Vigo, Javier Perez-Lara, and Fernando Caballero, **Robust Person Guidance by using Online POMDPs,** In: *Proceedings of the First Iberian Robotics Conference (Robot 2013),* Nov. 2013 *(accepted for publication).*

2012

- M. Nicolaou, V. Pavlovic and M. Pantic, **Dynamic Probabilistic CCA for Analysis of Affective Behaviour,** In: 12th *European Conference of Computer Vision* (*ECCV 2012), Florence, Italy*. October 2012.

- D.E. Karreman, E.M.A.G. van Dijk, V. Evers, **Using the visitor experiences for mapping the possibilities of implementing a robotic guide in outdoor sites,** In: *Proceedings of 2012 IEEE RO-MAN: The 21st IEEE International Symposium on Robot and Human Interactive Communication, IEEE International Workshop on Robot and Human Communication*, IEEE Computer Society, USA, ISBN 978-1-4673-4604-7, ISSN 1944-9445, pp. 1059-1065, 2012.

- D.E. Karreman, E.M.A.G. van Dijk, V. Evers, **Contextual analysis of human-non-verbal guide behaviors to inform the development of FROG, the Fun Robotic Outdoor Guide,** In: *Proceedings of the 3rd International Workshop on Human Behavior Understanding (HBU 2012),* Vilamoura, Portugal, October 7, 2012, Lecture Notes in Computer Science, Volume 7559/2012, 113-124, DOI: 10.1007/978-3-642-34014-7_10.

- G. Tzimiropoulos, J. Alabort, S. Zafeiriou and M. Pantic, **Generic Active Appearance Models Revisited***,* In: *11th Asian Conference on Computer Vision, (ACCV 2012).* Daejeon, Korea, November 2012.

2011

- L. Merino, J. Capitán,and A. Ollero, **Person Tracking in Urban Scenarios by Robots Cooperating with Ubiquitous Sensors,** In: *Proceedings of the Workshop ROBOT'11, pp. 1–8,* 2011.

5.3. User and Industry Workshops

5.3.1. Tour Guide Workshop

On 24 September 2014, Daphne Karreman and Vanessa Evers held a workshop for tour guides: three from the Royal Alcázar and one from the Lisbon Zoo.

Two of these had participated in the workshops in Year 1 of the project, one from the Lisbon Zoo and one from the Royal Alcázar.

At the end of this workshop the guides were asked whether they could imagine using the FROG as a tool to help them in their work. Suggestions included: entertaining some members of a party (for example, the children) while the guide explained more complex matters to those interested; the robot could show re-creations of the locations in earlier times (for example, the halls of the Royal Alcázar when they were still furnished, or the enclosures in the zoo when they were still cages); the robot could show visitors the behaviour of the animals in the wild, or, could show film taken earlier by the zookeepers inside the animals' living quarters.

The guides also suggested that people should pay for the tour so that only small groups of visitors would follow the robot.

5.3.2. Industry Workshop Presentations

IDM presented FROG robot platform at a Workshop organized by the System Evaluation Group on Ambient Assisted Living & CENELEC Technical Committee 100X, held in Brussels, March 10, 2014. This workshop has been attended by European AAL stakeholders, System Evaluation Group AAL, CENELEC Technical Committee 100X, Companies.

5.3.3. Other Workshop Presentations

IDM presented the FROG Project at a Workshop related with topic "Making Business with Robotics". Instituto Superior Técnico, Lisbon. This presentation targeted master students and SMEs.

UT On Monday 13 October 2014 the Dutch Night of Science and Society took place (avond van wetenschap en maatschappij; www.avondwenm.nl) in the Ridderzaal in the Hague. During this yearly event scientists and non-scientists from different fields discussed topics with each other on the theme Blueprint for the future – the science of today is the world of tomorrow. One of the topics was the introduction of social robots. Prof. Peter-Paul Verbeek introduced the topic of social robots in society to the table and Daphne Karreman supported the discussions with examples taken from the FROG project

UPO presented FROG during the European Researchers' Night, on September 26, 2014. The event consisted on an autonomous tour through the Royal Alcázar for the general public under registration (see Section 5.8), and a general poster presentation at Seville's town hall square.

5.4. Related Project Workshops

IDM presented the FROG project goals at two kick-off meetings: of the FP7 IP SQUIRREL[1] project in Freiburg in February 2014; and of the INSIDE[2] project from the Entrepreneurial Research Initiatives (ERIs) of the Carnegie Mellon Portugal Program, in Lisbon in July 2014.

1 SQUIRREL - Clearing Clutter Bit by Bit (http://www.squirrel-project.eu/)

2 INSIDE - Intelligent Networked Robot Systems for Symbiotic Interaction with Children with Impaired Development (http://www.cmuportugal.org/tiercontent.aspx?id=5233)

On 25 September 2014 the Consortium held a Peer Group Workshop with invited guests from relevant EU projects.

Guests:

- Paul Verschure – coord. EASEL
- Kai Oliver Arras – coord. SPENCER
- Juan Andrade Cetto – coord. Cargo-ANTS, ARCAS
- João Sequeira - coord. MonarCH

FROG Consortium members:

- Vanessa Evers
- Luis Merino
- Fernando Caballero
- Paulo Alvito

The program included:

- Informal introductions from participants about their own area of research and the (sort of) projects they were participating in. (max. 10 mins per person)
- A tour with the FROG robot (approx. 40 minutes)
- Opportunities to talk to the FROG young researchers in the on-site lab
- Time to discuss common goals - common problems and what can be improved with a view to making a bullet list of joint goals/conclusions/next steps for the future and possible new combined initiatives.

This workshop achieved interesting results. The participants highlighted that future emphasis should be on:

- something the common user (citizen) wants to see
- something the citizen can use (the public feels they pay too much for robotics)
- concentrating on one use case (rather than several) so that there is something to see at the end
- SMEs rather than large companies
- step ahead from pure navigation to something else
    - move from pure navigation to (physical) interaction
    - carrying things or moving (heavy/large) things out of people's way
- situational awareness
- more awareness of social context
- more interactions with the environment
- combine features of the environment and reason about people
- proxemics – mobbing the robot
- proxemics will change with the specific surroundings/ end user site

- lots of low-level planning
    - use more state-of-the-art motion planning
- study the difference between the movement of various robots – this is an unexplored area
    - smooth movements make robots look so much more elegant and professional
    - natural movement – the robot should move as elegantly as a dancer
    - design robots so that their motion looks good – and, also looks good on video and not only on paper
    - include artist/choreographer in the design team as well as navigation technologists
- use groups of robots
    - distribute tasks and knowledge
- track people and their movements – use mac address of mobile phones (there might be some privacy issues)

Notes for future initiatives:

- situational awareness
- Perception is not the way to go
- SSP expertise needed (Maja Pantic, Dirk Heylen)
- Machine learning
- Robots can understand people's motion in space – you can do a lot with that
- Is 'guide robots' still a good way to go?
    - A guide is a service robot
- Outdoor robots are (already) pretty good.
    - What else can you do with a robot on wheels? They have been around for 20+ years.
    - The best guide robot is a flying robot, as you don't have to deal with people on the ground or navigation.
- Take a closer look at the next call – then see what you can do with it – social awareness and so on… any application should be well in line with the call otherwise it will just get thrown out!
    - first decide on your use/user and then go on from there with your proposal
- Timing is also an important issue – tackle this middleware problem.
    - and it is an underexplored area in robots. There was a workshop in Bielefeld recently on Timing in HRI http://milab.idc.ac.il/timinghri/

General comment from a guest: Teaming up (this Peer Group Workshop) was a good idea: to see what we can do to take robotics to the next level.

- This reflected the comments we received from all participants. There was a lot of comparison of information on EU projects in general and management of projects in particular.

5.5. Data Sets and Open Source Software

FROG deliverable D6.2 presents 21 datasets recorded at Royal Alcázar of Seville (Spain) and at Lisbon Zoo (Portugal) with the FROG robot and at Royal Alcázar of Seville with a Pioneer robot. The data presented is available for free use under CC by-nc-sa. The two scenarios present interesting challenging characteristics: the Royal Alcázar of Seville constitutes a tourist hotspot that may have more than 5000 visitors per day; the Lisbon Zoo is a very irregular scenario with many ramps that makes localization tasks difficult.

We recorded a large set of image sequences from a stereo camera and scan measurements from three laser mounted on a moving robot and from an IMU sensor. The datasets are time stamped and stored by means of the well-known Robot Operating System (ROS) log functionality. The robot traveled more than one kilometer in each experiment, and half of the trials were performed at around midday and the other half at evening so we could capture the different light conditions over the images. The tourist attendance also depends on the hour, providing datasets with a lot of examples to model in a social-way the different places such as corridors, gates, queues, groups of people, etc.

This data is interesting for the evaluation of visual place recognition algorithms in both indoor and outdoor environments. Furthermore, the data can be used for person detection and tracking. Through further annotation, the dataset can be used to evaluate human-robot interactions in crowded areas. The deliverable is complemented with a dataset section in project website and all of the data is published there (https://www.frogrobot.eu/wordpress/datasets/).

5.6. Public Website

A public website has been created for the dissemination of project FROG: http://www.frogrobot.eu/

The FROG website has had three distinctive lives since the beginning of the project. In the first year, YD set up a *WordPress* website with professionally designed homepage and templates (see Figure 8). UT registered the domain *frogrobot.eu* and arranged to host the site. Eventually content management of the site was moved to the UT. However, the site did not go live until M6. The FROG first year review showed that the site was “satisfactory but could be improved”.

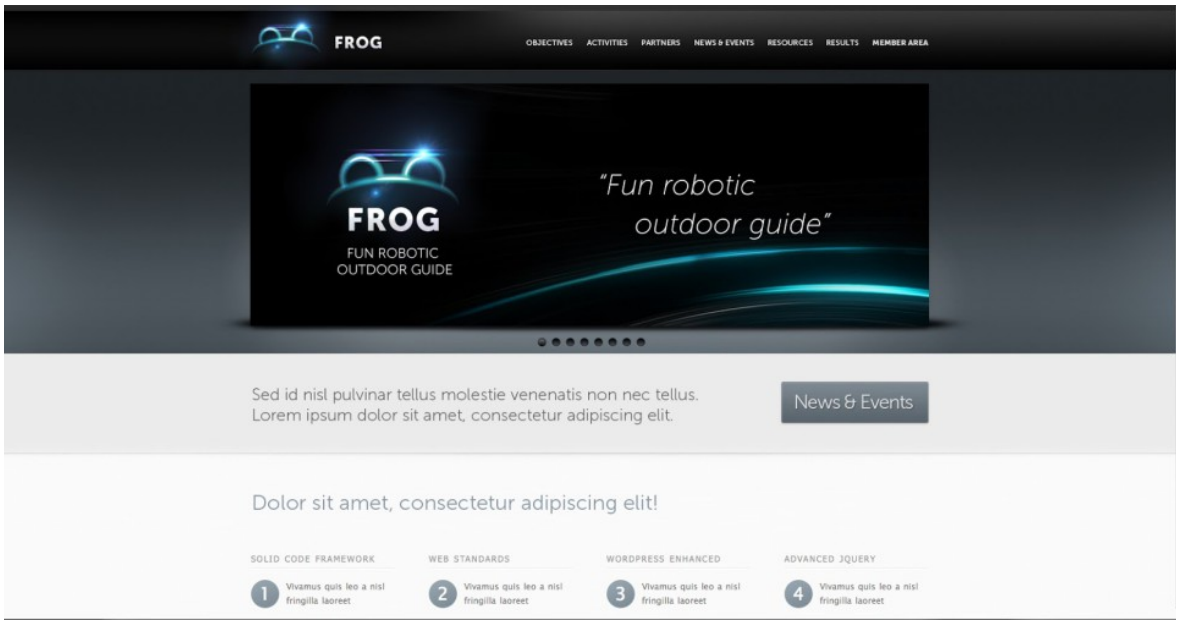

Figure 8. Design for FROG website in 2012

In year two, YD once again took over the website. They were to professionalize the site, leaving the research output page to the project management team. This sharing of tasks was eventually in place by M21.

When, in the third year, it was obviously proving difficult for YD to keep up with their tasks in the project the coordinator decided it was better for them to concentrate the resources they had available to Augmented Reality and UT once again took over the website. The website in its third and final incarnation was built as a shadow site and then put on line in M27. A simple website was built in a standard *WordPress Theme* (see Figure 9). The intention was to make sure that the research output was available and up to date and that project news and colour should be added as frequently as possible in blog form to appeal more to a general audience.

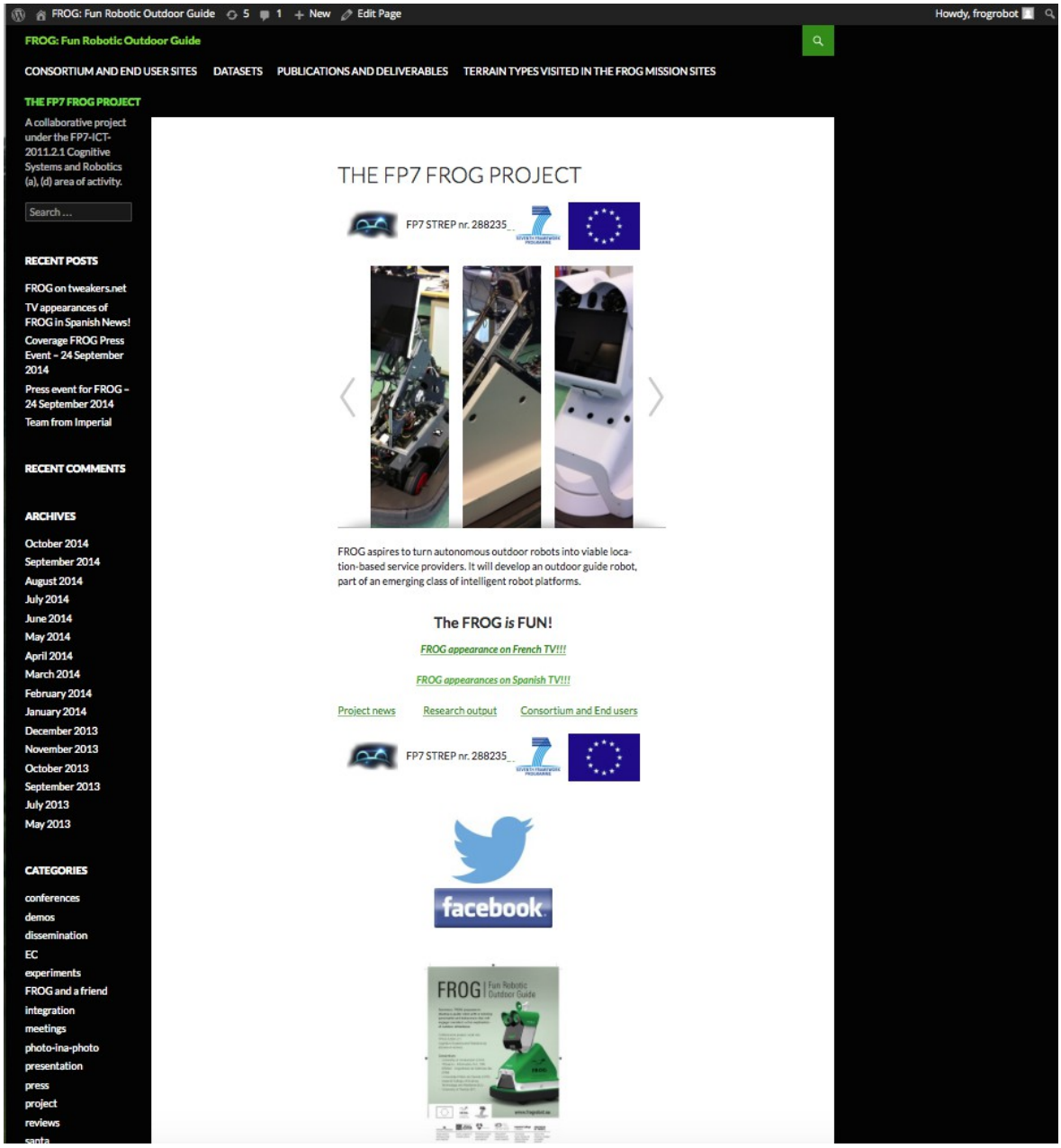

Figure 9. Homepage FROG website in 2014

The website now includes pages on:

- Consortium and End users sites
- Datasets
- Publications and Deliverables, with downloads
- The FP7 FROG Project and
- Terrain Types visited in the FROG Mission sites

There are more than 50 posts on:

- Dissemination and PR
- stories from integration meetings, experiments
- Consortium members (individuals and teams)
- the end-user sites and local events
- the FROG robots

One thing is not yet in place. The logging of how many people download the deliverables and publications, and from where, has proved difficult to get running again due to the reorganization of the UT's central ICT support and the fact that only that department has the user permissions to install the plugins.

5.7. Project Identity

To address the audience as one project, with all partners, we have created a corporate identity, consisting of a logo, project T-shirts, general flyers and identification stickers.

5.7.1. FROG Logo

During the process of setting up the first project web page, a coloured logo was created for the project. This logo is depicted in Figure 10 (left). Later, a B&W version of the same logo was made to ease the integration of the logo in some specific documents (see Figure 10, right).

Figure 10. FROG project logo. Right: coloured version. Left: B&W version.

5.7.2. Project T-shirts

Three different T-shirts were made and worn by the team members during the integration weeks. They are depicted in Figures 11, 12 and 13.

Figure 11. 1st year T-shirt..

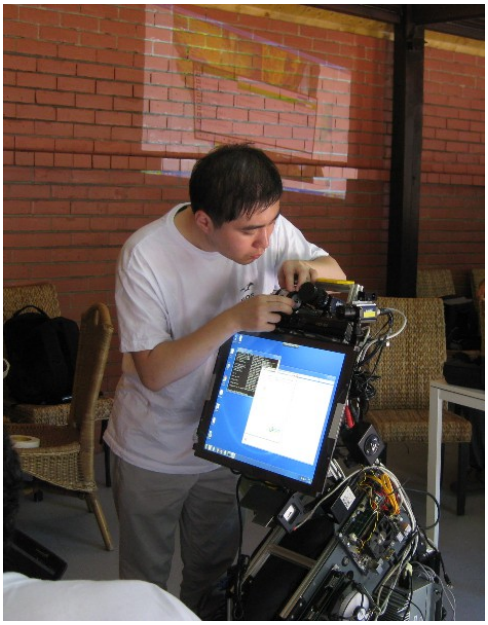


Figure 12. 2nd year T-shirt.

Figure 13. 3rd year polo shirt.

5.7.3. General Flyers

Two flyers were made for the project. The first one, a two sided folder depicted in Figures 14 and 15, was made during the first year of the project overviewing the goals of the project and its technologies. The second one, depicted in Figure 16, was made during the last year of the project, for the exhibition at the Hannover Messe 2014, again overviewing the goal of the project, each partner contribution and including an image of the FROG appearance.

Figure 14. Front and back face of 1st year folded flyer

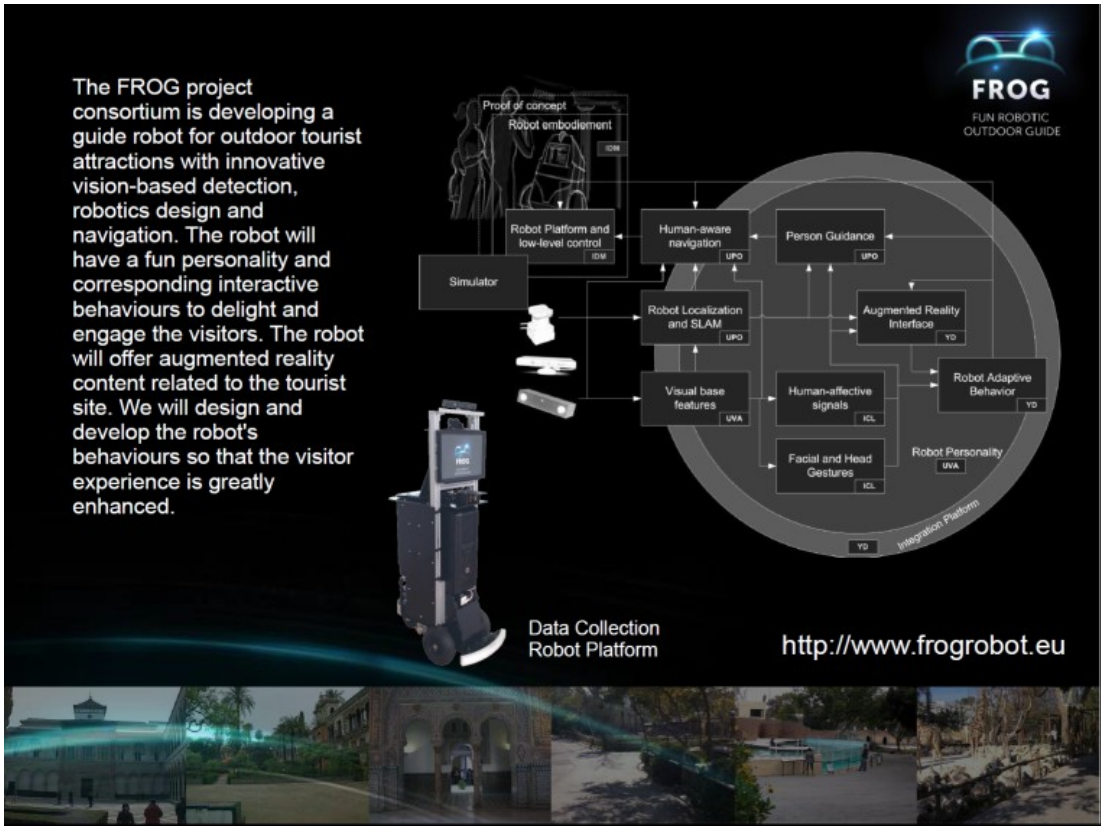

Figure 15. Interior faces of 1st year folded flyer.

Figure 16. 3rd year project flyer

5.7.4. ID Stickers

Some stickers were made to identify the project team. These stickers facilitated the identification of the members of FROG team by the staff of the hosting organization (Lisbon Zoo or Royal Alcázar) and also by the visitors. One of these stickers is depicted in Figure 17.

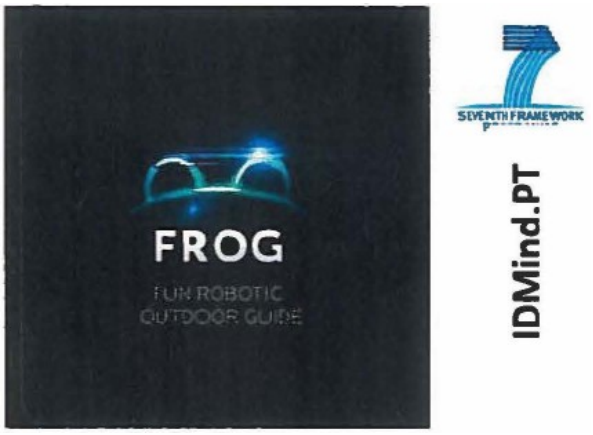

Figure 17. ID sticker example

5.8. Media Engagement

In Year 3 there were several TV appearances in France, Spain and the Netherlands.

The best coverage was on French TV. The report appeared on 16 July 2014 on channel TF1, considered to be the most viewed television channel in Europe, and is still available via the following link:

http://videos.tf1.fr/jt-20h/2014/les-touristes-de-seville-guides-par-un-droide-8453447.html

FROG first appeared on Spanish television on 4 March 2014. Luis Merino, Fernando Caballero and Javier Pérez were interviewed for Andalusía regional TV, Canal Sur. The report was later shown on other channels and the program can be found here, starting at approx. 20'30":

http://alacarta.canalsur.es/television/video/referendum-en-crimea--violencia-en-venezuela--sin-rastro-del-avion/1234430/264

On 3 April 2014, Vanessa Evers appeared on a prominent Dutch late-night talk show with the red UT Campus robot. The interview can be found here:

http://pauwenwitteman.vara.nl/media/312350

On 2 April 2014, FROG appeared on Dutch National TV with King Willem-Alexander of the Netherlands – the latter had opened a building on the Campus. Photos can be found here:

http://www.utwente.nl/fotomap/opening-gallery/index.html

On 11 October 2014, FROG appeared on tweakers.net. This is a Dutch website featuring news and information about hardware, software and the Internet. Members of the UT team explained and demonstrated the various capabilities of the robot. You can find the clip (which is in Dutch) here:

FROG on tweakers.net

Vanessa Evers was interviewed many times for Dutch TV and press. You can find more details on this on her website: http://vanessaevers.wordpress.com/

FROG appeared on Motherboard - an online magazine and video channel dedicated to the intersection of technology, science and humans:

http://motherboard.vice.com/read/the-frogbot-is-assuredly-the-most-adorable-telepresence-robot-around

5.8.1. FROG Press Event

On Wednesday 24 September 2014, the consortium held a press event in the Royal Alcázar in Seville. The robot was presented to the press in an event with the Rector of Pablo de Olavide University, the Director of the Royal Alcázar, Vanessa Evers as coordinator of the FROG consortium, and Luis Merino from UPO. In the event, the robot made a short autonomous tour for the journalists (see Figure 18).

Figure 18. FROG Press Event

The event was covered on Spanish national television and radio, Andalusian television and radio, in numerous newspapers and on news websites. In Annex I there is a detailed list of the press coverage. This can also be found in the following links:

https://www.frogrobot.eu/wordpress/press-event-for-frog-24-september-2014/

https://www.frogrobot.eu/wordpress/coverage-frog-press-event-25-september-2014/

5.8.2. European Researchers Night 2014

On Friday 26 September 2014, Luis Merino presented the FROG robot by means of an autonomous guided tour in the Royal Alcázar in Seville for 20 persons who registered for the visit in the frame of the European Researchers' Night 2014:

http://lanochedelosinvestigadores.fundaciondescubre.es/investigadores/luis-merino-cabanas/

Finally, a group of nearly 40 visitors was following the robot (including other visitors to the Alcázar), among them many children as depicted in Figure 19.

Figure 19. European Researchers Night 2014

A short video of the event can be seen at:
https://www.youtube.com/watch?v=aMOhdN1_vUU

Later on, Luis Merino also presented the project to the public attending the general event.

5.9. Demonstrations

The project results are implemented in demonstrators, as specified in the list of deliverables. During the three years of the project the FROG was shown many times to the public on the two testbeds, the Royal Alcázar in Seville and the Lisbon Zoo. In 2014 the Consortium met four times (Feb, Apr, Jun and Sep) for integration/testing and in the final experiments 26 official tours were given. The robot has always attracted much attention during these demonstration as depicted in Figure 20.

Figure 20. FROG in the spotlight. Left:in the Lisbon Zoo. Right: in the Royal Alcázar.

FROG was presented at the Hannover Messe, from 7-9 April 2014, in the form of the red UT Campus Robot. The three Dutch universities of technology (3TU) presented themselves at the Holland High Tech House, which was part of the two-thousand-square-metre Holland Pavilion. With 65 square metres, 3TU was the largest Holland Pavilion participant. IDMind and UT were on hand to present FROG (see Figure 21).

Figure 21. FROG at the Hannover Messe 2014

6. Technology Exploitation Strategy

This section presents the strategy that will be adopted by the FROG partners for the exploitation of the project results. The consortium partners' individual exploitation plans are presented, in order to clarify their intention regarding the project results. These individual exploitation plans will guide the definition of a common strategy for the exploitation of the FROG exploitable results.

Figure 22. FROG: Fun Robotic Outdoor Guide

6.1. Value Proposition

FROG aspires to turn autonomous outdoor robots into viable location-based service providers. Despite its innovative features as an emerging class of intelligent robot platforms, it is foreseen that upon its release in the market a FROG based solution will be in competition with existing products and services in the addressed domain. The objective of this section is to present what, according to the project partners, is the main value proposal of FROG and its strongest features.

According to the partners, one of the main value proposals of FROG is to promote the use of robotic characters in the exploration of outdoor historical and cultural sites. Outdoor recreation providers face the challenge of responding to constantly evolving technologies and the changes they create in the public's recreation desires and expectations. Moreover, outdoor recreation providers are seeking ways to increase youth participation in recreation activities and bring them to the outdoors. This often requires that the activities they offer be challenging, fun and incorporate innovative technology. By researching the issues involved in creating a robust mobile robot that has engaging behaviour based on a fun personality, FROG is contributing to provide outdoor historical and cultural sites with innovative tools they eagerly desire.

During the project execution FROG is being deployed over two completely different test beds – the Lisbon Zoo and the Royal Alcázar in Seville (see Figure 23). This strategy has two important advantages. First it increases the impact of the project while increasing the interest of potential end-users. Secondly, it shows the flexibility of the system, which is an important strength of the project.

Figure 23. FROG at Royal Alcázar, Seville, September 2014

6.2. Individual Exploitation Plans

The projected plans for the exploitation of the outcomes are now presented. From the individual exploitation plans described below, we can see that all the FROG partners intend to exploit the results developed within the project. The two main strategies preferred by the partners are naturally dependent on their nature: academic partners will look to capitalize on the knowledge acquired during the project activities by developing further research in their respective fields of expertise; the SME intends to integrate FROG results with its own product and services enhancement, and/or to develop a new business opportunity based on the project concept.

As agreed by the project consortium, the Intellectual Property Rights (IPR) of the foreground developed within the project belong to the partners that took part in its development. Therefore, before the start of the exploitation of the results, it is important to clarify which partner owns right over which exploitable result.

6.2.1. Academic Partners

The academic partners, UVA, UPO, ICL and UT, will exploit the results of FROG as input and state of the art for further research as evident in future research projects. EU FP7 projects TERESA, SQUIRREL, EASEL where combinations of the FROG partners are involved (UT, IDM, UPO, ICL) show the possibilities that FROG provides to offer integrated skills to new research projects to build further from state of the art that is being achieved in the FROG project.

UT Prof. Dirk Heylen has already introduced the UT's red FROG (the Campus Robot) in his course for first year students Computer Science students. He sees it as a good platform for students to help him study interesting questions in his domain of Socially Intelligent Computing.

UPO will exploit the results by integrating them into teaching course material and carry out bachelor and master's theses in the context of FROG. Furthermore, the knowledge will be incorporated into PhD programs in which the researchers of UPO participate.

From the experience of FROG, the localization component can be adapted to provide pose information in the way AR applications require, easing the integration with those products.

The exploitation route of the navigation component includes adapting it to other applications in which robots offer services in crowded scenarios.

UPO has also maintained contacts with the Royal Alcázar, which has shown further interest in developing these technologies for this site. Furthermore, UPO has been contacted by AED Engineering GmbH, a company located in Munich, Germany, interested in the navigation technologies developed in the project for their transfer to other applications; and by FAICO, a technology and innovation centre located in Seville, and which is also involved in projects using IT for theme parks and Zoos.

UVA has cooperated with Daimler R&D to apply technology for video-based pedestrian pose estimation from a mobile platform not only to the social robotics domain (i.e. FROG) but also to the intelligent vehicle domain [Flohr et al., T-ITS 2014]. In the vehicle domain, Daimler has already introduced an active safety system in its 2013-2014 Mercedes-Benz S-, E-, and C-Class models, that automatically warns the driver and/or brakes the vehicle in dangerous situations with pedestrians. The aim is to develop the next-generation pedestrian safety systems that are more effective by reacting earlier to potential dangerous traffic situations with pedestrians. This could be done by the incorporation of pedestrian pose, as indicator for pedestrian intent, in motion modelling and path prediction (see also initial work by [Kooij et al., ECCV 2014]).

6.2.2. SME

Within the scope of the FROG project, IDM has developed and assembled an outdoor differential robot platform for terrains with an urban character. This platform will be included in the company's product line offer for the research and educational market. IDM started selling the platform base in 2014. Meanwhile, in 2013 IDM has already sold one robot, based on FROG, to UT (see Figure 24).

Figure 24. UT's FROG red "brother".

IDM will first focus on the commercialization of their own intellectual property only (pre-existing and developed within the project). After completion of the project the company will manage the use of their property with the other partners. This will be on a licensing basis subject to the IPR guidelines of FROG.

Dissemination materials produced within the FROG project that document the demonstration of the robot in the two testbeds will be used to create a product-fact-sheet that will support the marketing of the product. Based on this and to take full advantage of the important track record that "FROG", the "Fun Robotic Outdoor Robot", already has, IDM proceeded to the trademark registration of FROG.

Two trademarks were meanwhile registered. The first one, named "FROG ROBOT", was registered at the Portuguese Institute of Industrial Property (INPI) as a National trademark, under class 7[3] of Nice's Classification. This first registration was made only at a national level to test for any possible opposition. Meanwhile this registry has passed all the evaluation process and FROG ROBOT™ is now a Portuguese trademark. Following the first successful registry, IDM proceeded to the registration of the trademark named "FROG – FUN ROBOTIC OUTDOOR GUIDE", at the Office for Harmonization in the Internal Market (OHIM), this time as a Community figurative trademark, as depicted in Figure 9.11, under classes 7 and 41[4] of Nice's Classification. This registration is in process of examination.

Figure 25. FROG registered Community trademark.

The registration of FROG under classes 7 and 41 of Nice's Classification, respectively, "Robots" and "Interactive entertainment services", follows what IDM believes are the two possible ways of exploiting FROG: as a product that can be customized and sold to a specific client to be used in a specific use case scenario; as a customized service for a specific use case scenario. There is also the possibility of selling the robot platform to third party integrators, and in this case this would follow the B2B model.

Nevertheless, to enhance the possibilities of business exploitation, IDM will keep the FROG robot available after the project conclusion with its functionalities. Beside the great impact that this will have on the dissemination of the project results, it will ease the promotion of a business exploitation plan based on the FROG concept. It will also help in defining extra engineering efforts that might be needed before its final commercialization as an off-the-shelf solution.

Meanwhile IDM will be contacting potential clients to create an emblematic project where the FROG robot can be deployed on a permanent basis. The Lisbon Zoo is at the forefront with regard to this possibility, its Administration has demonstrated a lot of interest in having a FROG robot after the

3 Class 7 - Robots [Machines]
4 Class 41 - Interactive entertainment services

conclusion of the project and contacts are being established with potential sponsors to support the installation of FROG on a permanent basis. One of the biologists from the Lisbon Zoo joined the Tour Guide Workshop on 24 September 2014 and had definite ideas about what the FROG could present to be a good robot platform for use in the zoo. IDM has been invited to make a presentation and demonstration tour with the FROG during the European Zoo Educators (EZE) Conference[5] from the European Association of Zoos and Aquaria (EAZA), hosted by the Lisbon Zoo this next March 2015. This will an excellent opportunity to enforce to promote the FROG concept within the Zoo network.

The Consortium has been invited to showcase FROG at the International Tourism Trade Fair (FITUR[6]), which is one of the largest tourism industry fairs in the World, with more than 200.000 visitors. This also shows the potential of FROG which can be exploited has a marketing tool due to the WOW factor generated by its presence.

If the scientific and technological challenge of FROG ended in September 2014, IDM believes that FROG's exploitation challenge is just starting.

5 http://www.eaza.net/News/Pages/ezeconference.aspx

6 http://www.ifema.es/fitur_06/

References

[Flohr et al., T-ITS 2014] F. Flohr, M. Dumitru-Guzu, J. P. F. Kooij and D. M. Gavrila, "A probabilistic framework for joint pedestrian head and body orientation estimation", under review (minor revision) at IEEE Trans. on Intelligent Transportation Systems, 2014.

[Kooij et al., ECCV 2014] J. F. P. Kooij, N. Schneider, F. Flohr and D. M. Gavrila. "Context-based Pedestrian Path Prediction". Proc. of the European Conference on Computer Vision (ECCV), Part VI, LNCS, pp.618-633, Springer, 2014.

Annex 1. List of the press coverage of the press event on 24/09/2014

Television:

CANAL SUR CSUR NOTICIAS 2, 24/09/2014 21:04:43 (01:31).

CANAL SUR MAS QUE NOTICIAS, 24/09/2014 15:37:26 (00:47).

TVE1 Andalucía INFORMATIVO ANDALUCIA, 24/09/2014 14:08:34 (01:27).

Radio:

Canal Sur Radio HORA SUR MEDIODIA, 24/09/2014 14:53:01 (00:51).

CANAL SUR 2 CSN ANDALUCIA 2, 29/09/2014 21:09:44 (01:25).

RNE-1 LAS TARDES DEL CIUDADANO GARCIA, 10/10/2014 17:26:59 (06:03).

Cadena Ser LA VENTANA, 26/09/2014 17:46:31 (01:42).

Printed Press:

«Frog», robot y guía turístico
ABC SEVILLA, 25/09/2014 pág. 30.

FROG, UN ROBOT PARA ENSEÑAR MONUMENTOS
DIARIO DE SEVILLA, 25/09/2014 pág. 68.

Un guía 2.0 recorre el Alcázar
DIARIO DE SEVILLA, 25/09/2014 pág. 13.

PLEASE, SIGA AL ROBOT DEL SIGLO XI
EL CORREO DE ANDALUCIA, 25/09/2014 pág. 11.

Frog, otra forma de conocer el Real Alcázar
EL MUNDO SEVILLA, 25/09/2014 pág. 4.

Un guía de última generación
VIVA CAMPO DE GIBRALTAR, 25/09/2014 pág. 16.

Un guía de última generación
VIVA HUELVA, 25/09/2014 pág. 16.

Un guía de última generación
VIVA JAEN, 25/09/2014 pág. 16.

Un guía turístico muy especial
VIVA SEVILLA, 25/09/2014 pág. 7.

Digital Press:

Un guía turístico de última generación
@ ELDIARIO.ES, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ ELECONOMISTA.ES, 24/09/2014 .

Un guía turístico de última generación
@ ELECONOMISTA.ES, 24/09/2014 .

Un guía turístico de última generación
@ ES.FINANCE.YAHOO.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ EUROPA PRESS, 24/09/2014 .

Presentan un robot para ocio turístico que interactúa con los humanos
@ AGENTTRAVEL.ES, 25/09/2014 .

Un guía 2.0 recorre el Alcázar
@ DIARIO DE SEVILLA, 25/09/2014 .

Un guía 2.0 recorre el Alcázar
@ DOSHERMANAS.PORTALDETUCIUDAD.COM, 25/09/2014 .

«Frog», el robot guía turístico sevillano que interactúa con los humanos
@ ABCDESEVILLA.ES, 24/09/2014 .

«Frog», un robot que es guía turístico e interactúa con los humanos
@ ABCDESEVILLA.ES, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ ACTUALIDADES.ES, 24/09/2014 .

Un guía turístico de última generación
@ ANDALUCIA INFORMACIÓN, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ Diario Barcelona, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIO DE ÁVILA DIGITAL, 24/09/2014 .

El guía turístico del siglo XXI
@ DIARIO DE SEVILLA, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ Diario Murcia, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOALICANTE.EU, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOALMUNECAR.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOAYAMONTE.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos

@ DIARIOBAILEN.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOBENALMADENA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOBILBAO.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOBUJALANCE.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOCABRA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOCASTELLON.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOCHIPIONA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIODETORREMOLINOS.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOECIJA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOESPEJO.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOEXTREMADURA.ES, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOFUENGIROLA.ES, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOFUENSANTA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOGIBRALTAR.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOGRANADA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOGUADALAJARA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOHUELVA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOJEREZ.ES, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOLACAROLINA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOLUGO.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOMELILLA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOMIJAS.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOMOSTOLES.DIARIOMADRID.EU, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOPALENCIA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOPOZOBLANCO.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOPUERTOSANTAMARIA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIORONDA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOSABADELL.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOSANTANDER.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOTENERIFE.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOVELEZ.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOVIGO.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOVILLACARRILLO.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOVITORIA.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ DIARIOZARAGOZA.COM, 24/09/2014 .

'Frog', un robot para ocio turístico que interactúa con los humanos
@ GRANADAENLARED.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ LA VANGUARDIA SPAIN, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ LAINFORMACION.COM, 24/09/2014 .

Un guía turístico de última generación
@ LAINFORMACION.COM, 24/09/2014 .

Presentado FROG, un robot para ocio turístico que interactúa con los humanos
@ LARIOJANEWS.COM, 24/09/2014 .

Un guía turístico de última generación
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