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ViewBricks: A Participatory System to Increase Social Connectedness for the Elderly in Care Homes

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Abstract. Driven by the maturing of Internet and the development of the Internet of Things, people are becoming connected not only via the smart personal devices, but also via the increasingly responsive and connected environments, which brings up new opportunities to involve potential user group like elderly people into this network through tangible interaction and embedded systems. This paper presents the design and implementation of a participatory view-sharing system which consists of a group of specially designed camera kits and a gallery-like interactive installation, aiming to increase the social connection between elderly people living in a care home and the local communities around. The camera kits are designed to provide openness for local people to share sceneries via public participation, while the interactive installation presents the continuous real-time changes of the shared outside views, and triggers further communication between sharers and receivers through a "postcard-sending" metaphor. In this study, we mainly explore the possibilities of connecting people and facilitating social interaction through the combination of online and offline sharing behaviour, as well as the application of IoT technology.

Keywords. Elderly, Social Connectedness, Social Interaction, Responsive Environments

1. Introduction

Ageing has become a global topic with critical challenges for modern society. In Europe, by 2025 more than 20% of Europeans will be 65 or over, with a particularly rapid increase in numbers of over-80s [1]. Currently, most attention of design and technological solutions for this growing population is paid to physical health, mobility and safety. In the field of social wellbeing and mental health, which are also important in ageing process, there is however much space to explore [2, 3].

In recent years, the maturing of Internet and the rapid development of the Internet of Things (IoT) drive people to be increasingly connected with each other through the smart personal devices, as well as through networked environments. Our social life and behaviour in the cyber world is gradually merged into the physical world [4, 5], which brings up new possibilities to involve potential user groups, like the elderly, into this public network and social life, through tangible interaction and embedded technologies in real-life environment.

In this paper, we mainly present the research project ViewBricks, which is deployed to explore how we can adopt IoT-related technologies to enhance the social

connection between the elderly in care institutions and the surrounding local communities. We firstly introduce the specific background of this context and the related work. Then, we describe our current research exploration and illustrate the design and implementation of our project in detail. The insights and future work are discussed in the final part of this paper.

2. Background and Related Works

2.1. Social connectedness of elderly

Elderly people, especially the ones living in care institutions, usually experience a reduction in their social circles and a decline in their engagement with local activities. Increasing online and offline thresholds to get connected put them at the risk of becoming socially isolated [6, 7]. This is one of the important reasons why current care institutions make great efforts in social services and activities.

Online thresholds to be socially connected are mainly due to the high learning load of modern technology [7]. Media and Internet based tools usually update and change very fast, and have little in common with the traditional products in terms of interaction and product semantics. It takes the elderly much more time than the younger generations to learn and remember how to use them, which can result in anxiety for not doing well. There is a need to find a suitable access to build the connection and transition between modern and traditional technologies, so as to involve elderly people into modern social life more mildly.

Offline thresholds usually follow the decline of physical condition and the transition in social life along with the ageing process. Sensory decline, like reduced vision and audition, and decline in mobility physically limit the elderly's action radius, keeping them indoors. This reduces their opportunities to meet people and join social activities. When moving into a care home, some elderly people leave the places where they have lived and worked for decades, and live far from their families and original social circles. The unfamiliarity of the new environment can result into the growth of social barrier [6].

Current solutions to increase elderly's social connectedness mainly focus on two directions: (1) enhancing the social tie between elderly and their families through games and smart home products, like the multi-player sports games [2, 8] and the digital photo sharing system [9]; (2) providing social interventions to encourage the elderly to share experiences and meet new friends, such as social activities, internet training, home visiting [6, 10]. The first direction focuses more on strengthening the social ties within limited family members, but does not consider much about the potential of enriching the elderly's social resources, like improving the connection with people in the neighbourhood. The second direction helps in building more social relationships, but requires heavy investments in organizing, managing and maintaining the activities and services, which makes it hard to be sustainable.

Given the above analysis, there is a chance to explore how design intervention with the application of modern technology can help in improving or extending the elderly's social connections with other people in their local community through a participatory and more sustainable way.

2.2. Interactive environment and connected "Things"

To lower the threshold of engaging elderly people into the interaction and digital service, tangible solutions and sensing technology are widely adopted in current design for smart products and environments. The interaction and embedded systems in living environments usually fit people's life style with intuitive operations, learning people's behaviour and giving feedback in situ [11]. There are examples like using the interactive wall embedded in living environment to help reducing wandering behaviour of dementia elderly through motion sensing and media feedback, and using the lighting and sound installation to improve experience in care home's public space via sensory simulation [12, 13]. Furthermore, in public contexts like indoor common spaces or the streets outdoor, tangible interventions not only help engage people with the interaction, but also contribute to facilitating social interactions between participants [14, 15]. This may also help in increasing social connections between elderly people and other participants.

Meanwhile, Technological advances, like the growing open-source hardware platforms in IoT development, lower the threshold for the public participation in real-life data sensing and sharing. The smart "Things" are becoming more connected with simplified building process and enriched data collecting and sharing approaches [4, 5]. This also provides possibilities to enrich the things that can be shared between elderly and local communities, as well as the ways to share them.

3. Design of ViewBricks System

In care homes, many of the elderly people hold strong emotion and rich memories towards specific places, including the places with unforgettable personal experience and the ones where big events or issues happened. However, the online and offline thresholds hinder them from revisiting the places or keeping updated with the happenings in those areas via social media or photo searching.

This actually leaves space for design researchers to explore whether it is possible to help filling up this gap by creating a view-sharing experience of those places between elderly people and the local communities, which can finally contribute to the improvement of the social connection between them.

Thus, in this study, an initial participatory system is designed, called ViewBricks (Fig. 1). It consists of a group of specially designed camera kits (ViewBricks) for local people to openly share constant real-time videos and images from different places, as well as a gallery-like interactive installation to present the shared contents in the care home and trigger further communication between sharers and receivers through a "postcard-sending" metaphor. The system is implemented mainly to explore the possibilities of connecting people and facilitating social interaction through the combination of online and offline sharing behaviour, as well as applying related IoT technology into everyday life.

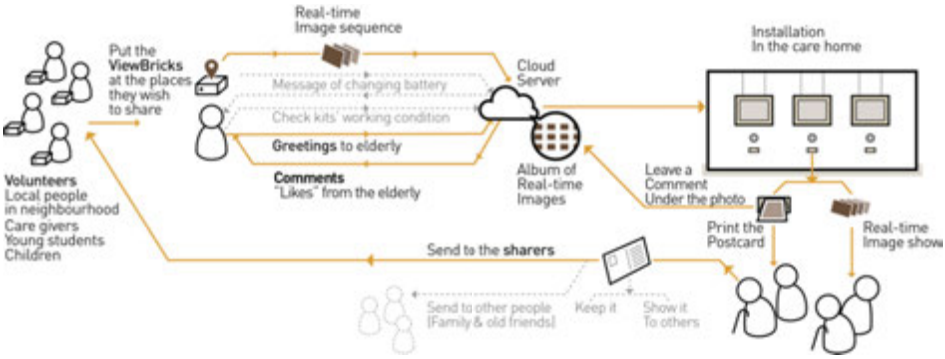

Figure 1. Structure of ViewBricks System.

3.1. ViewBricks for view sharing

The view-sharing kits (the ViewBricks) are wireless networking image collectors, which can automatically take pictures or record videos at regular intervals and upload the captured contents to the online server via 3G network simultaneously (Fig. 2). They are portable and can work independently in outdoor environment.

Volunteers from local communities are assigned with the viewbricks and encouraged to put them wherever they wish to share a view with the elderly who live in a care home and cannot have long-distance or long-time outdoor activities every day. As the viewbricks require low learning cost to share sceneries, all that volunteers need to do is to put them on some stable surfaces, let them face the views they want to share, and turn the kits on. Then, the viewbricks will take and upload the photos at a speed of 1 photo per minute via 3G network. In this version, we use Flickr as the Internet server for storing photos. Each volunteer will receive an account to check the real-time uploaded pictures and the working condition of the viewbricks.

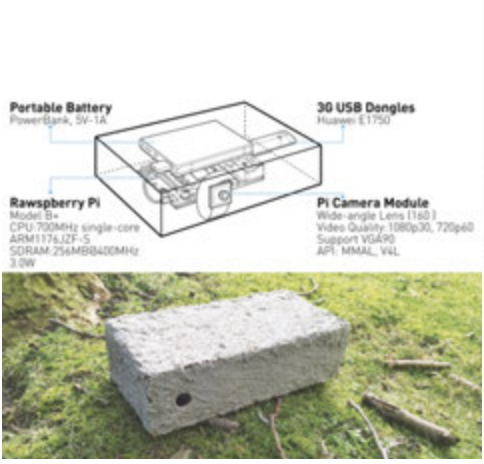

Figure 2. Structure of ViewBricks.

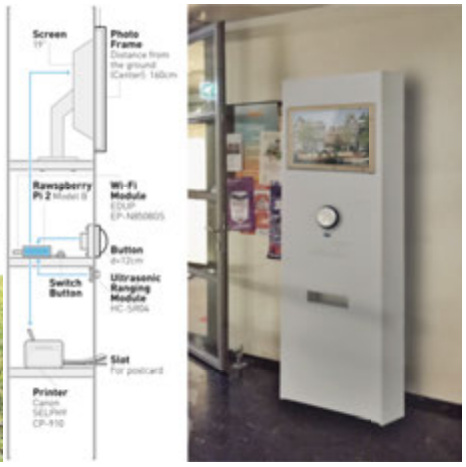

Figure 3. Structure of the installation (1 unit).

3.2. The Interactive gallery to build connection

The second part of the ViewBricks system is the Gallery-like interactive installation (Fig. 3). It is designed in a tangible interface and vintage style to suit elderly people's perception and preference, which can also fit into the surroundings of the care home. The sceneries in the frames, however, are digital images shared from the viewbricks in real time. The installation has three photo frames hanging on its wall, and each frame has a button and a slot right under it. When the button is pushed, the view shown on the screen will be printed out as a postcard out of the slot.

We choose the corridor of the ground floor in a care home as the location for the installation, which is a common space open to all the residents and the neighbourhood around. Many of the elderly in care home walk along the corridor to the dining hall for meals or public activities. When they pass the corridor and get close to one of the photo frames, the system will detect their location and behavior, then the still picture starts to be dynamic and runs a 30-second slideshow like a time-lapse animation. The elderly can see the delicate changes of the views as time passed in the last several hours. When the slideshow is over, the photo frame stops at the latest image and continues the updating at the speed of 1 image per minute (Fig. 4). If the elderly are attracted by this and enjoy what is happening somewhere outside at the moment, they are encouraged to push the button, and the scenery shown on the screen will start to "fall down". Then the elderly can receive a real postcard from the slot with a picture exactly same as shown in the photo frame. On the backside, there is the address and messages from the volunteer who shares the view. The elderly can choose to keep the postcard or write it back to continue the conversation (Fig. 5).

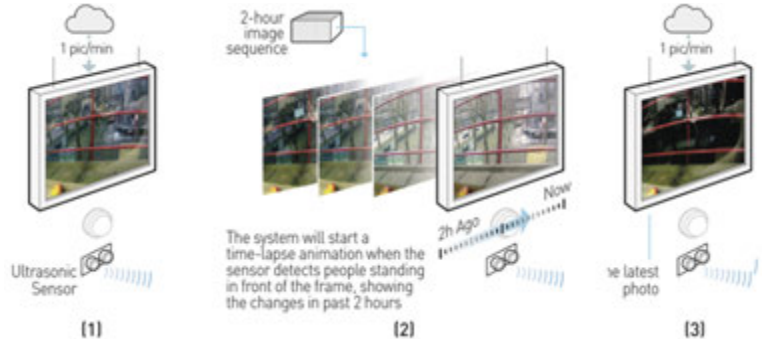

Figure 4. Interaction of time-lapse slideshow.

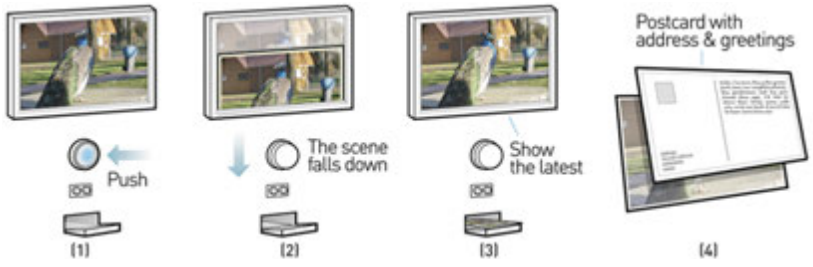

Figure 5. Interaction of printing the postcards.

This postcard with greetings becomes a media to build up the connection between the elderly inside the care home and the volunteers outside through a conversion transited from cyber to physical world. Besides, when the button is pushed down, there will also be a comment made online right under the photo in the sharer's Flickr album, saying that the elderly like the view and print it into a postcard. The more the elderly push the button and print, the more popular the view will be (Fig. 6).

In this design, we tend to explore the possibilities of providing new view-sharing experience to help increase the elderly's social connectedness. With the ViewBricks, what local people can share with the elderly are not only the past moments in shared places, but also the chances of knowing what is happening and what will happen, which actually help create shared experiences between sharers and the elderly for potential communication in future. The "postcard-sending" metaphor in this design works for translating the interaction in digital language into physical ones for the elderly, and provides physical evidence to trigger social interaction between the elderly and other people.

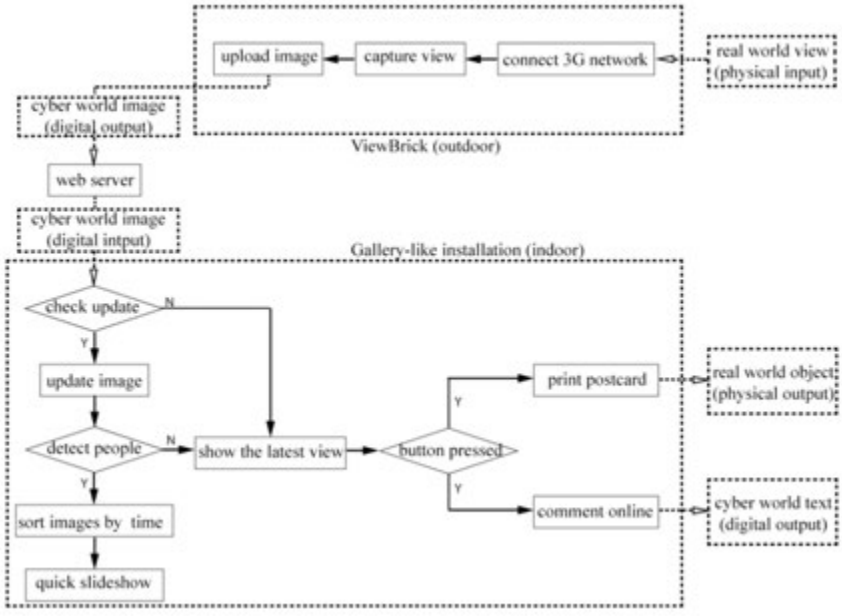

Figure 6. Framework of ViewBricks system.

4. Implementation of ViewBricks System

4.1. Structure and Technical solution for ViewBricks

In this project, the ViewBricks mainly work for data collecting. In order to be stable, power saving and not distracting in the located environment, the kits are designed with a look like the common bricks made of cement in Netherland cities. They are humble, strong, and sealed with waterproof material inside to against the heavy rain, strong wind, pressure, collision and being stolen (Fig. 2).

Inside the ViewBricks, we use Raspberry Pi (Model B+) as the core component to control the camera module and connect to the Internet, which has relatively lower power consumption with satisfying performance and is convenient for development and test in the R &D phase.

The wide-angle (160 degree) camera module is applied in this project for a good view of outdoor scenery. It has a five-megapixel fixed-focus camera that supports 1080p30, 720p60 and VGA90 video modes, as well as the still capturing, which can provide pictures with a relatively good quality on 19" screens. It can be accessed though MMAL and V4L APIs [16]. The third-party library (Picamera Python library) is used for camera control in this system.

There is no official 3G module for Raspberry Pi yet, thus we choose 3G USB dongles for 3G connection. The model used in this system is Huawei E1750, which has been tested working fine with Raspberry Pi after setting up.

A Powerbank battery (output 5V-1A) is our current power solution to support ViewBricks. Given the limited surface area of ViewBricks, the conversion rate of most current solar panels on market and the lack of sunshine in the Netherlands, we are struggling with the solution to use solar battery and still trying to find a better power supply for ViewBricks.

The key program of ViewBricks is to capture images and upload them to the online social media server via API—Flickr API in this case. A shell script is also created to establish 3G connection and then call this program at regular intervals. The safe work time for each ViewBricks is tested and recorded, and an email or SMS will be sent by the system to users as a reminder when it is time to change battery, in order to avoid the power off without shutdown, which may damage the device.

4.2. Construction of the installation inside a care home

In order to fit the vintage style of the environment and engage the elderly in a natural and mild way, we hide everything that looks digital or technological behind a new wall built specially for the installation (Fig. 3). Raspberry Pi is also used to implement the main function of the installation for its advantage in size. We choose Raspberry Pi 2 (Model B) this time for the need of more complicated computing work and less limitation in power consumption. Wi-Fi Module (EDUP EP-N8508GS) is used for the Internet connection. Ultrasonic ranging module (HC-SR04) is adopted to detect the distance of the object passing by, connected to the Raspberry Pi via the General-purpose input/output (GPIO). It provides 2cm to 400cm non-contact measurement function with the accuracy of 3mm. There are also two buttons connected via GPIO, one is for the developers to exit the system and the other one is the button for the users to print the postcard. The printer, Cannon SELPHY CP-910 is adopted for printing postcards and photos, which is in a size small enough to be hidden behind the wall and can print cards in a relative high speed and good quality.

5. Discussion and Future Work

In this paper we present a participatory view-sharing system, ViewBricks, which consists of a group of photo-capturing kits and a gallery-like interactive installation. The goal of this system is to explore an inter-disciplinary approach to involve potential group, the elderly, into the view-sharing experience responsive and connected

environment based on the "Internet of Things". The system provides services for the elderly who live in care home by enhancing their connection and social support from outside.

Through the design and implementation process, we initially highlight some important factors to help improve social connectedness via this system, based on the initial feedback from the caring home faculties, and plan to explore them through the improvement of content selecting, interaction and sustainability of this system.

5.1. Important factors of the system

The first factor is the **constant real-time view sharing**. It directly presents what is happening outside at the moment that they are watching, which contributes to facilitate the connection between remote places via the synchronism of real-world changes. Furthermore, instead of showing past moments that other people have experienced, the real-time views provide shared experiences between sharers and receivers to see what will happen in shared places together, which have potentials to facilitate further communication.

The second factor is the **interactivity** of the system, which mainly contributes in two important aspects: (1) enhancing the connection between elderly and the outside; (2) providing the transition between digital language and the physical one. Printing postcards provides the elderly a sense of creating influences and getting feedbacks from the other side of the frames, which helps enhance the connection through interaction, instead of only showing the images. The printing operation also represents the fact that elderly people like the specific shared sceneries. It translates the elderly's offline appreciation into similar online behaviour, such as "like" and "favorite". The further operations like showing the postcards or sending them to other people can be considered as transformed "forward". The greetings printed on postcards stand for online postings from sharers, and the replies through postcard sending from the elderly will be offline "commenting".

The third factor is the potential to trigger **social interaction** between participants. Besides the aim of providing tangible interaction, the postcard-sending metaphor also emphasizes the fact that the sceneries are something that local people wish to share and talk about with the elderly, rather than some randomly chosen views with little meaning. The inviting sentences in printed greetings also leave opportunities to trigger further communication via writing replies. Meanwhile, the choice of embedding the interactive installation into the common space is also based on the purpose of creating more opportunities for the elderly to encounter with each other and start co-located conversations, which helps to motivate senior residents to pay attention to the system and also contributes in increasing social connectedness.

The fourth factor is the **public participation**. Improving social connectedness needs a long-term intervention, which means the system will require constant updates in content or interaction to attract users. The spreading and maintaining of the camera kits, the location changing, and the communicating via postcards can hardly be carried out only through service providing from the care institutions in a top-down mode. The public participation of local communities is necessary for the sustainability of the system, technically and socially, and a suitable mechanism to support the participation also needs to be explored.

5.2. Future work

For choosing locations, we start with encouraging people to share typical places in city that can be recognized by most of people, while the places having strong emotional connections with the elderly should also be added. Recommendations from participants for place choosing can be found out in interviews after the experiment. At the same time, emotional impacts brought by the sceneries are need to be considered as well, since the depressed sceneries that can call up bad memories should be carefully dealt with.

The interaction of the installation currently focuses on receiver side, and mainly happens indoor. In further development, the interaction on sharer side and outdoor needs to be considered, which includes the interaction between indoor installation and outdoor kits, the direct social interaction between sharers and receivers, and the possible interaction in shared places that can attract outside people to join the system.

Finally, solutions to maintain the sustainability of the whole system will be explored in further development. For projects based on public participation, a suitable mechanism to provide proper tasks and awards is necessary to keep people engaged with the system. Shared needs and interests also need to be explored, in order to motivate different groups of participants to join the communication and social interaction.

6. Conclusion

ViewBricks system presented in this paper is a design practice, based on the research goal of exploring possibilities to increase social connectedness of the elderly living in care homes, through the combination of online and offline sharing behaviour, as well as the adoption of IoT-related technologies. The system consists of a gallery-like interactive installation and a group of view-sharing kits. The elderly's connection with the shared places and social interaction with the sharers can be facilitated through the "postcard-sending" interaction. The important factors found in design and implementation will be improved in future iteration, in order to refine the interaction, enhance the connected relationship, and sustain the engaging experience and user participation.

In current stage, we design this system to find out the factors that can affect users' social behaviour that happens not only inside the care home but also in the interaction outside. The whole system is kept flexible and able to be modified for different study purpose in related areas.

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Introduction to the Proceedings of the Workshops of IE'16

London, United Kingdom 12–13 September 2016

Intelligent Environments (IEs) refer to physical spaces in which IT and other pervasive computing technologies are woven and used to achieve specific goals for the user, the environment, or both. IEs have the ultimate objectives of enriching user experience, improving the management of that environment and increasing user awareness.

Research in IEs is driven by inventive, innovative and fast-paced ideas, and, as such, there is a sense of urgency in materializing them, assessing their practical implications, and verifying whether they deliver their promised results. The mantra for research in this area is well conveyed by a thought brought to us by Steve Jobs: "Let's go invent tomorrow instead of worrying about what happened yesterday". Workshops, as brief gatherings towards the establishment of collaborations and incitement of creativity, are the ideal venue for creating and sharing this "tomorrow".

The 12th International Conference on Intelligent Environments focuses on the development of advanced intelligent environments, as well as newly emerging and rapidly evolving topics. In the present edition, we are pleased to include in this volume the proceedings of the following workshops and symposia that emphasize multidisciplinary and transversal aspects of IEs, as well as cutting-edge topics:

- 5th International Workshop on Smart Offices and Other Workplaces (SOOW'16);
- 5th International Workshop on the Reliability of Intelligent Environments (WoRIE'16);
- 1st International Workshop on Legal Issues in Intelligent Environments (LIIE'2016);
- 2nd International Symposium on Future Intelligent Educational Environments and Learning (SOFIEE'16);
- 2nd International Workshop on Future Internet and Smart Networks (FI&SN'2016);
- International Workshop on Intelligent Environments Supporting Healthcare and Well-Being (WISHWell'2016);
- International Workshop on Computation Sustainability, Technologies and Applications (CoSTA'2016);
- Creative Science 2016 (CS'16) and Cloud-of-Things 2016 (CoT'16);
- Workshop on Wireless Body Area Networks for Personal Monitoring in Intelligent Environments (WBAN-PMIE);
- Physical Computing Workshop.

As is visible from the list, the workshops and symposia organized in conjunction with the main conference provide a forum for researchers, scientists and engineers to engage in many interesting and active discussions that will encourage further research in these key areas of Intelligent Environments.

The proceedings contain a series of contributions reflecting the latest research developed in IEs and related areas, focused on stretching the borders of the current state of the art and contributing to an ever increasing establishment of IEs in the real world.

It is our aim to inspire readers in their own work, in the hope that reading these proceedings plants the seeds for new, interesting, and original ideas.

We would like to thank all the contributing authors, as well as the members of the Organizing Committees and Program Committees of the workshops and symposia for their highly valuable work, which contributed to the success of the Intelligent Environments 2016 event. We are also grateful to the conference organizers and local staff who worked for the success of this event.

Thank you for your help, this event would not exist without your contribution.

As a final note, the Workshops Chairs would like to take the opportunity to thank Professor Juan Carlos Augusto and the other members of the IE'2016 organization for the trust they placed on us.

We are looking forward to seeing you all in London and actively participating in these exciting workshops.

September 2016
Paulo Novais, Universidade do Minho, Portugal
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5th International Workshop on the Reliability of Intelligent Environments (WoRIE'16)

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