EMPATHY: 3rd International Workshop on Empowering People in Dealing with Internet of Things Ecosystems

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Nowadays, when dealing with Internet of Things (IoT) for people with no prior experience in programming or in designing technology, End-User Development (EUD) solutions offer wide and powerful approaches to support end-users in designing their own IoT smart things and systems. The main goal of this edition of the workshop is to encourage and stimulate a wealthy confrontation on heterogeneous topics related to EUD for IoT applications that exploits different interaction paradigms and innovative interface design. The outcome of the workshop are thought-provoking contributions that range from accessibility and security for IoT systems and devices up to personalization of smart objects.

1 INTERESTS AND GOALS

In recent years, the diffusion of the so-called smart devices, objects connected to the internet that can be personalized by end-users, has grown significantly. Low-cost sensors and actuators have become widely available, contributing to the realization of the Internet of Things (IoT) vision. This wealth of devices can be exploited by directly involving the people that will use them in their environments. A relevant approach in this sense is End-User Development (EUD). EUD is defined as a set of methods, techniques, and tools that allow users of software systems, who are acting as non-professional software developers, to create, modify, or extend a software artefact [13].

Even if much attention has already been devoted to different aspects of EUD, investigating this methodology is still crucial, given the new challenges presented by the evolving IoT landscape. Existing solutions for configuring smart objects ranges from the completely automated approach relying on artificial intelligence to systems that allow users to personalize the behaviour of their devices to their will. It is important to consider the different levels of user control

that the technologies, frameworks, and approaches in this continuum expose and to examine how to balance these aspects for each user and each application.

One defining aspect of EUD is that it promotes the abstraction from low-level details, making the participation of end-users in the process of application creation easier. This allows people to put focus on the aspects that are more relevant to them, such as designing automations to make an environment more tailored to their needs.

Another aspect of the EUD approach in the IoT context is related to designing applications capable to react to dynamic events generated by sensors, objects, services, devices, and people. To be able to support EUD in such a setting, we must consider that only the end-users know how their application should behave. For this reason, a tailoring environment has to be easy to learn, allowing the end-user to gain the most value from their custom applications, obtain better control over them and improve the user experience. This perspective can also consider humanoid robots in the IoT ecosystem. Such devices use a set of sensors and actuators to handle their interaction with the people and the environment, hence tailoring platforms can be used to define their behaviours [8, 12].

A solution that has received interest in this regard is trigger-action programming. Rule-based approaches are intuitive since end-users can reason about a personalized application in terms of contextual events and corresponding desired system reaction, for example, allowing a therapist to configure individual exercises for children on the autism spectrum [1]. However, they introduce some subtle difficulties, such as expressing complex rules that use logical operators. A non-programmer end-user may hence end up with programs that do not behave as expected. Therefore, further effort in investigating aspects such as how to enable users to express rules comprised of multiple triggers and actions to define more flexible behaviours [11] are needed, to move from the banal synchronization of smart objects towards the definition of complex smart environments [2].

Moreover, the capability of IoT devices to collect and make available large amounts of sensitive data leads to a higher number of privacy and safety issues [5]. For example, in a smart home data regarding the individuals living in the house can be tracked through the observation of the cyber and physical activities of connected domestic devices, assisted living systems, or smart meters. Since it is currently not possible to protect end-users from all potential security threats, all users must take a role in the management of privacy and security. Furthermore, the process of creating behavioral rules through EUD might sometimes introduce issues into the smart environment for which the end-user is directly responsible. Such issues might generate security and privacy flaws that could both damage the smart environment and leak end-users' personal data [17].

2 CHALLENGES TO DISCUSS

This section reports on recent challenges in EUD for the IoT context that are expected to be discussed in the workshop. A relevant topic is how new modalities besides the visual one, such as those based on conversational agents or augmented reality can be introduced to improve the interaction with the smart environments, and how the different paradigms can be compared [9]. The interaction should not only take into account the effectiveness standpoint but also how transparent the generated automation and the interplay between them are for the user. From this perspective, it is interesting to examine how tailoring platforms could provide also analysis tools, to deliver on request statistics and information about the actual use of the rules that can help to understand the user's needs [14]. Another relevant topic is how intelligent suggestions can support users during the personalization of automations, for example investigating how different styles of rules recommendations are perceived by users [15].

Another relevant challenge is to cater the varying needs of people with different levels of expertise and experience, and of different age groups. EUD solutions dealing with IoT for people with no prior experience of programming or no

experience of designing technology may widely differ in approach as compared to others who may have this experience to some extent. Similarly, the requirements will vary according to age. Supporting end-users, especially children, to design their own IoT smart things and systems, can empower them and positively affect their beliefs and understanding of design of IoT-enabled smart devices [16]. If the IoT-based solutions and environments, designed specifically for younger end-users are playful and gamified, they can engage such young end-users throughout all the stages of design such as exploration, ideation, programming, prototyping, and reflection, even when they do not have any prior related experience of designing such smart devices. Furthermore, providing them opportunities to reflect across these design stages, both collaboratively and individually, can help them acquire a critical thinking approach and an awareness of what it takes to ideate and program smart devices [10].

An important contribution of Human-Centered design involves the Cultural Heritage topic that can exploit the Internet of Things to improve the fruition of cultural resources by enabling visitors to manipulate intelligent objects, receiving information that stimulates emotions, the comprehension and content appropriation. By introducing innovative interaction paradigms and EUD approaches, it becomes possible for non-technical users and non-IT experts to customize and evolve software systems that use visual languages and heterogeneous platforms. In this way, curators and guides of cultural sites can offer Smart Interactive Experiences [3, 4] and multiple possibilities of interaction with cultural objects (which become 'smart' or 'augmented'), thus creating in the cultural sites innovative IoT-based environments detached from pre-packaged and scarcely flexible systems.

Important contributions could be provided for addressing security and privacy issues concerning both the smart environment and end-users' personal information. In fact, EUD solutions could empower end-users in the definition of behaviors aimed at protecting their smart environment from external threats [7]. Moreover, since non-technical users are not provided with sufficient knowledge on security and privacy topics, they might not be aware that, by defining behavioral rules through EUD, they can introduce flaws generating security, safety, and privacy risks. To this end, is important to seek solutions guiding the end-users towards the definition of more secure behaviors, identifying possible inconsistencies introduced at design-time [6]. Furthermore, research should also foster solutions for providing motivation about how risks have been identified. In fact, one way to educate users from repeating the same mistakes can be to explain, perhaps through some example scenarios, the situations that may arise if the defined rules were activated in the smart environment.

3 ORGANIZATION

The 3rd international workshop on Empowering People in Dealing with Internet of Things Ecosystems Workshop (EMPATHY) is co-located with the international conference on Advanced Visual Interfaces (AVI 2022) that has been organized in Frascati, near Rome (Italy).

In the past, there have been two editions of the EMPATHY workshop both featuring active participation and considerable interest in themes and contributions: the first edition, held at Island of Ischia (Italy) in conjunction with AVI 2020, was organized as a half-day event featuring 11 accepted papers authored by more than 25 researchers while the second edition was a full-day event held in Bari (Italy) in conjunction with the INTERACT 2021 conference and welcomed more than 35 researchers with 11 accepted papers.

The format for this third edition is a full-day event oriented towards discussions, hands-on sessions, and presentations while the target audiences mainly consider people from Academia, Research Institutes, Companies and professionals (designers, UX experts, Interaction and UI designers, makers).

The latest workshop aims to serve as a venue for discussing ongoing research and sharing ideas for researchers and practitioners working on solutions to personalize the behavior of IoT ecosystems, encouraging participation in order to have stimulating discussion from various perspectives. The proposed topics included: End-User Development (EUD) for IoT, interaction paradigms for IoT, usability of IoT Systems, interface design for IoT, intelligent interface for IoT systems, accessibility for IoT systems, virtual and augmented reality for EUD in IoT settings, conversational user interfaces for EUD, usable privacy and security in IoT systems, personalisation and recommendations for IoT, IoT for cultural heritage, ubiquitous computing and mobile human-computer interaction, human-centered artificial intelligence in IoT contexts, and industry case studies.

The workshop has been structured to maximize the time allocated for group discussion and brainstorming. In the beginning participants will be welcomed and introduced to the workshop's goals and organizers, then the accepted papers will be presented. People will be encouraged to provide short but provoking presentations that tackle questions in line with the workshop goals. Therefore, about 15 minutes will be provided for the presentation of their work followed by a few minutes of Q&A. The workshop will thus continue with a discussion on future directions and on the main challenges and controversial aspects that characterize the current landscape for the EUD of IoT systems. The workshop will be wrapped by the presentation of results and will be concluded with the agenda definition identifying ways to move forward. This can include initiation of joint publications, organization of a new edition of the workshop and publications on the topic.

An overview of the schedule is:

- 09.00-09.15 Welcome and Introduction
- 09.15-11.45 Paper presentation
- 11.45-12.15 Coffee break
- 12.15-13.00 Brainstorming and discussion
- 13.00-14.30 Lunch
- 14.30-15.30 Future directions and wrap-up
- 15.30-16.00 Presentation of challenges
- 16.00-16.30 Coffee break
- 16.30-17.00 Presentation of the results
- 17.00-17.30 Agenda definition and Publications

The final versions of the accepted papers will be published in the CEUR Workshop Proceedings (http://ceur-ws.org/), indexed by Scopus while workshop results will be published on the Empathy website (https://empathy-ws.github.io/2022/)

3.1 Submissions

The workshop received 10 valid submissions (featuring the participation of more than 35 researchers) six of which from Italian universities and research institutions and four from foreign institutions like Maynooth University (Ireland), University of Calgary (Canada), University of Bristol (United Kingdom) and University of Jena (Germany).

The submissions covered topics and research problems related to user model services that measure personality traits to support configuration tasks in EUD contexts together with toolkits that helps young generations in the design of inclusive smart things, as well as the area of ubiquitous musical interaction design for music therapies remodeling IoT devices also considering new frameworks to grapple with IoT non-users, incidental users and unaware subjects.

When modeling languages for non-technical IoT users that could create their own processes exploiting a query language for process models, the identification of possible ECA rules security issues supported by natural language explanations are also very important.

Of great interest are the contributions regarding smart systems to support seniors with neurocognitive disorders utilizing IoT devices and mixed reality, as well as Ambient Assisted Living solutions for the cognitive resources of older adults using humanoid robots and serious games which can be supported by IoT devices to improve visiting experiences of cultural sites favoring tangible interactions.

3.2 Organizers

The workshop organizers come from different universities and research institutes and have been collaborating with each other in the EMPATHY project funded by the Italian Ministry of Education, Universities and Research (MIUR):

- Fabrizio Balducci is currently Assistant Professor (RTDA) at the Computer Science department of the University of Bari "A. Moro". He serves as reviewer for international journals such as Entertainment Computing, IEEE Access, Multimedia Tools and Applications and Sensors, he is regularly in the TPC of conferences in the area of Artificial Intelligence and Interactive Entertainment and has been Online Experience co-Chair for IFIP INTERACT 2021, Associate Chair for ACM CHI Play 2020 and 2021 (Work–in–Progress track), Associate Editor for the international journal Simulation & Gaming edited by SAGE. Research interests include Human–Computer Interaction, Pattern Recognition, Game Studies and UX.
- Bernardo Breve is a PhD Student at the Department of Computer Science of the University of Salerno. His research interests include artificial intelligence, data science, and Human-Computer Interaction, with emphasis on usable security and privacy for end-users. He has been a member of the program committee of the International DMS Conference on Visualization and Visual Languages since 2020, where he served as Publicity co-Chair and Program co-Chair in 2021 and 2022, respectively. He also serves as a reviewer for international journals, such as Multimedia Tools and Applications (MTAP), and ACM Transactions on the Web (TWeb).
- Federica Cena is an associate professor at the Computer Science Department of the University of Turin. She works on the intersection of Artificial Intelligence and Human-Computer Interaction. In the last years, she is mainly devoted in studying the implications of Internet of Things for user modeling and personalisation, with a special focus on assistive applications for cognitive disabilities and frailty. She is the author of more than 100 scientific publications at conferences and in international journals.
- Andrea Mattioli is a research fellow at CNR-ISTI, HIIS Laboratory and a PhD student in Information Engineering at the University of Pisa. His research interests are in the field of Human-Computer Interaction, specifically in personalization for IoT applications, augmented reality and recommendation systems for smart environments. He serves as a reviewer for international journals and conferences, such as ACM Transactions on Interactive Intelligent Systems (TIIS), International Journal of Human-Computer Studies (IJHCS), and International Conference on Intelligent User Interfaces (IUI).
- Mehdi Rizvi is a postdoc researcher at Politecnico di Milano, Italy. His research focuses on the design of interdisciplinary tools and platforms for citizens and domain-experts. Such tools often either follow the no-code/low-code paradigm, or tangible interaction, or are in the form of conversational agents, making the interaction by end-users easier. Outcomes of his work have been published in various international research

journals and conference proceedings, and also have been exhibited to the general public in the form of interactive art exhibitions.

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