Workshop at The Ninth International Conference on Information and Communications Technology for Sustainability (ICT4S 2023) (Rennes, France, June 5, 2023)

Green Software and Human Actors: design, code, and behavior

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***Abstract*—This workshop aims at building a community on research questions related to reducing software energy consumption by end-user lever. Application energy consumption includes server-side, routing, and client-side questions that are already tackled from technical viewpoint, but improving efficiency requires adopting at the same time end-user practices that prevent rebound effect. Hence, the main research question is for green software and human actors to do the best choices and behaviors to keep energy consumption sustainable.**

***Index Terms*—Green Software, Sustainability, Human Actors**

I. Background

Today, the Internet infrastructure is about to replace most of the communication and information broadcasting infrastructures built during the XIX and XX centuries and expand it to every country all over the world. The energy cost of such a holistic and automated information system is a core and dual, human and technology question. Energy costs include server-side costs, routing costs, and client-side energy costs. Human factors include satisfying end-user needs, giving control, and taking into account daily life constraints.

A compelling example is choosing video stream bandwidth quality. Behind this simple choice of everyday life lies a difficult problem that video providers seem not to manage yet: what does the best video stream bandwidth quality mean? On the client side, it means satisfying end users, adapting quality to users' activity, adapting to devices' capacities, and adapting to content interests. On the server side, it means managing broadcasting calculation, hardware cooling, and video coding consumptions. On the routing side, it means offering the best optimized service, the best payload, and the best security. Therefore, tackling such an everyday question requires balancing many factors between users and technology.

Research communities in ICT started tackling energy consumption questions at least since humanity started facing energy crisis and climate crisis. Those investigations built several skills on various topics, ranging from technical solutions and approaches (such as measuring software consumption, optimizing hardware and network, software eco-design), to social and behavioral approaches (such as changing user behaviors), to design approaches (such as designing green web pages, or designing green interfaces).

This workshop aims at building bridges between the different communities working on improving the energy efficiency of the technological base (hardware and software) and those working around human actors (behavioral studies, UI/UX design). We aim to combine all these skills for improving end-user application usage from an energy consumption viewpoint. We also aim at gathering extra skills that would be needed to answer major research questions: (1) how to guide user interface designers for energy-efficient interaction? (2) how to assist end users for energy-efficient interaction? And (3) how to provide data to end users for energy-efficient digital behavior?

The objective of this workshop is thus to raise interest and start building a community around these research challenges.

II. Organisers

Adel Noureddine[1] is an Associate Professor at the University of Pau and Adour Countries (Pau, France) since 2018. He has a PhD in computer science from the University of Lille and Inria research center in 2014, and has been working in green IT and green software since 2010. His main research interests are in green IT, software engineering, behavioral studies, autonomic computing and empirical studies. He is co-founder of the Sustainable/Eco-Responsible Software working group at CNRS's GDR GPL, and currently leading an ANR project on the role of end users in software energy reductions. Recently, he has been part of the organizing committee of Greening the Web Workshop, Intelligent Environments conference, and Compas conference. He has also organized two editions of the Green IT summer school in France, and is organizing the 3rd edition in 2023.

Guillaume Rivière[2] is Assistant Professor at ESTIA INSTITUTE OF TECHNOLOGY (Bidart, France) since 2011. His background lies in Computer Science (MSc in 2005) and his research work focuses on Human-Computer Interaction (PhD in 2009). He co-leaded the French Working Group on Tangible Interaction (2011-2018) and the French Working Group on Persuasion for Sustainability (2019-2021). He was also part of the organization team of national HCI Young Researchers Days (RJC-IHM 2006), chair of national conference demonstration sessions (Ergo'IA 2014, IHM 2017), chair of

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national conference work-in-progress sessions (IHM 2019), and program chair of a national conference (IHM '20'21).

III. Type of workshop

Full-day workshop and evening social event.

We expect a couple of dozen participants that would be curious and interested in the research question and motivated for further community building.

IV. Pre-workshop plans

Speakers will be recruited from our research (academics, industry) networks (no call for speakers). Speakers will comprise people from academia and industry, in particular with inviting leading speakers in green software, and green design. Participants will be recruited by a call for participation (see below). We expect participants from academic research, industrial research and development, industry, and local governments.

Communication plan is the following:

- A website hosted on our university domain will publish the description, information, and materials of the workshop.
- The call for participation will be broadcasted on academic mailing lists (e.g., HCI communities, data centers communities, software engineering, eco-design) and professional social networks (e.g., LinkedIn).
- We plan to take photos of the workshop during the workshop that will be published on the website (participants will be asked for permission).

V. Workshop Structure/Activities

The program of the full-day workshop (summarized by Table I) is the following:

A. WORKSHOP MORNING

- **Opening** (Organizers: Guillaume Rivière, Adel Noureddine 10 min)
- **Background Presentations**
  - Software Energy Efficiency (Adel Noureddine, 30 min talk, then questions)
  - HCI and Climate Change: Toward New Directions (Guillaume Rivière, 30 min talk, then questions)
- **Invited Keynote**
  - To be confirmed (Aurélie Baton & Christophe Clouzeau, 60 min, then questions)
- **Research Questions**
  - Tackling applications Energy Efficiency from End-user side (Adel Noureddine, 10 min)

Required resources:

- Room with chairs (Small conference room if possible, for 20-30 persons)
- Video-projector display
- Microphone if possible
- Coffee break
- WiFi for participants and speakers
- Laptop connected to Internet and video-projector

B. LUNCH

Lunch provided by ICT4S conference.

C. WORKSHOP AFTERNOON

- **Participants Involvement**: 1 slide per participant : Name, Affiliation, Background, Topics, Own questions (1-2 minutes each)
- **Presentations from participants related to the topic** (60 min)
  - Research ideas
  - Previous work and skills
  - Future works, projects, directions
  - 10 minutes per talk
  - For voluntary then selected propositions
- **Passionate discussion**
  - Passionate discussion
  - Who is interested in the research question? (researchers, business, local governments)
  - How to tackle the research question?
  - What skills and technologies are needed? What is the TRL of required technologies? Is the community ready? Which community?
  - What research agenda for next months and for coming years?

Required resources:

- Room with chairs (meeting room if possible)
- Video-projector display
- Whiteboard with marker pen
- Coffee break
- WiFi for participants and speakers
- Laptop connected to Internet and video-projector

D. EVENING SOCIAL EVENT

- Free participation to the social event and gathering drink and/or dinner
- Not mandatory
- Reservation to be done during the workshop
- Open to people that did not attend the workshop
- Cost not included in workshop fees (participants pay their meals/drinks)
- Details will be given on time

TABLE I
Workshop Summary

	Description
Morning	Scientific talks, challenges, and keynote
Noon	Lunch
Afternoon	Participants' self-introductions, selected talks, and passionate discussion
Evening	Social event

VI. Call for Participation (CfP)

Achieving the ambitious goals for sustainability requires collaboration between different research disciplines and domains, as the impact of technological-only optimizations slows down. In this community workshop, we aim to build bridges between green software and green IT, UX/UI design, and behavioral studies. The workshop will bring communities together to share ideas and design, build and sustain the next generation of sustainable computing, involving human actors (such as end users, developers, and deciders).

This full-day workshop aims at building community. We expect people from academia, industry, and local governments. Two 30-minute presentations from academics will take place in the morning on software energy efficiency, and on HCI and climate change, followed by a 60-minute keynote. After 2-minute self-introductions from all the participants, selected and voluntary 10-minute presentations will take place during 1 hour. Then, discussion will take place in the afternoon about required skills to answer major research questions: (1) how to guide user interface designers for energy-efficient interaction? (2) how to assist end users for energy-efficient interaction? And (3) how to provide data to end users for energy-efficient digital behavior?

Proposals for 10-minute presentations will be submitted on EasyChair. An abstract up to 500 words will depict speakers' presentation. Abstracts and presentation slides will be published on the website of the workshop.

- Proposal deadline: 7 April 2023.
- Notification of acceptance: 21 April 2023.

The participants will be asked to send their 2-minute self-introduction slide by e-mail a week before the workshop.

VII. Conclusion

Our full-day community workshop aims to provide an interdisciplinary venue for researchers and practitioners from multiple research communities (green computing, software engineering, UI/UX design, behavioral studies, and humanities) to meet, brainstorm, and share ideas, identify key interdisciplinary challenges, and plan future collaborations.

References

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