Offer #2024-07935

Characterization of energy-aware design for battery-less devices

Contract type: Fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Function: Temporary scientific engineer
Level of experience: From 3 to 5 years

About the research centre or Inria department

The Inria Centre at Rennes University is one of Inria's eight centres and has more than thirty research teams. The Inria Centre is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

The NOP project is funded by LabEx Cominlabs for the period 09/2021-12/2024. It aims to design energy-aware building blocks for autonomous IoT platforms that are self-powered by ambient energy harvesting, with applications in the field of smart sensors.

The consortium consists of four teams with complementary skills: ASIC (IETR): ultra-low power architecture; Granit (IRISA): digital communication and autonomous networked objects; PACAP (Inria): compilation and real-time systems; STR (LS2N): embedded software.

28 months after the start of the project, several milestones have been reached. A formal model adapted to the description of intermittent reactive systems has been proposed. This model was used to formalize and solve the optimal scheduling problem in an energy-aware intermittent system. These results have then been used as the basis of the implementation of the first energy-aware RTOS dedicated to intermittent systems. In parallel, a dedicated compile-time code optimization technique has been designed. By optimizing jointly memory mapping and checkpoint placement, it provides very significant energy savings.

Efforts are currently focused on the development of the demonstration platform and the application. For the platform, the hardware design has been validated and production is in progress. For the application, software prototypes have been developed, feasibility has been validated and relevant software components have been identified: pre-processing, neural network, classification, and transmission.

Assignment

One of the main bets of the NOP project is that the cost of implementing an energy-aware approach will be less than the benefits obtained. The evaluations carried out so far, both at runtime and at compiler level, show very significant gains indeed, far greater than the additional overheads. However, what is not currently planned in the project roadmap is a more detailed evaluation covering the whole platform over its entire lifecycle.

Specifically, we identify three main cost/benefit trade-offs that need to be assessed:

- Design phase: additional development time to characterize the energy models of hardware and software components vs. gain from transparent implementation (for the developer) of intermittency support mechanisms.
- Operation phase: consumption of resources required for on-line measurements and decisions vs. absence of code replay, minimization of checkpoints, and optimization of sleep times.
- Late operation phase: sensitivity of energy-aware vs. energy-blind intermittent systems to component ageing.

Main activities

As far as exploring runtime trade-offs is concerned, we believe that the trade-offs can vary quite a lot depending on the profile of the application. A very simple application of the sensor-digitization-
transmission type is unlikely to benefit as much from the gains offered by the energy-aware approach as a more complex application involving, for example, additional stages of classification, anonymization or encryption, or a more reactive application with quality of service constraints.

We therefore propose to develop a set of benchmarks corresponding to different application profiles. Proposing such benchmarks will be a first contribution to the state of the art. We will use these benchmarks to finely characterize the different costs associated with managing intermittent performance with our approach, as well as approaches that are representative of the state of the art, both at runtime and at compilation level.

**Skills**

Technical skills and level required:

- proficiency in C and C++ languages is required
- understanding of assembly language is a plus

Languages: English (read, written, spoken)

Relational skills: ability to work in a team

**Benefits package**

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- Partial payment of insurance costs

**Remuneration**

Monthly gross salary from 2695 euros based on experience

**General Information**

- **Theme/Domain**: Architecture, Languages and Compilation
  Software engineering (BAP E)
- **Town/city**: Rennes
- **Inria Center**: Centre Inria de l'Université de Rennes
- **Starting date**: 2024-10-01
- **Duration of contract**: 6 months
- **Deadline to apply**: 2024-09-04

**Contacts**

- **Inria Team**: PACAP
- **Recruiter**: Rohou Erven / erven.rohou@inria.fr

**About Inria**

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

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**Instruction to apply**

Please submit online: your resume, cover letter and letters of recommendation eventually

**Defence Security**:

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.
Recruitment Policy:
As part of its diversity policy, all Inria positions are accessible to people with disabilities.