Towards Autonomous Utility-Aware Energy Management for Energy Harvesting Devices

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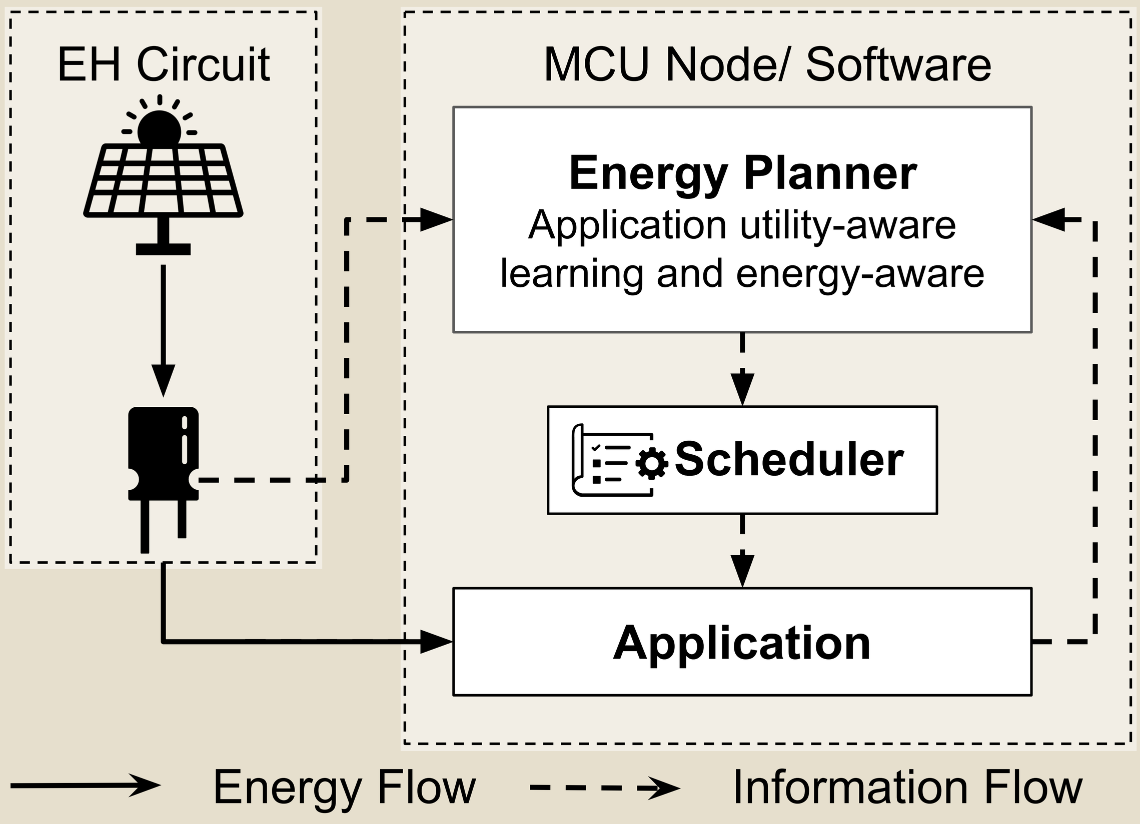
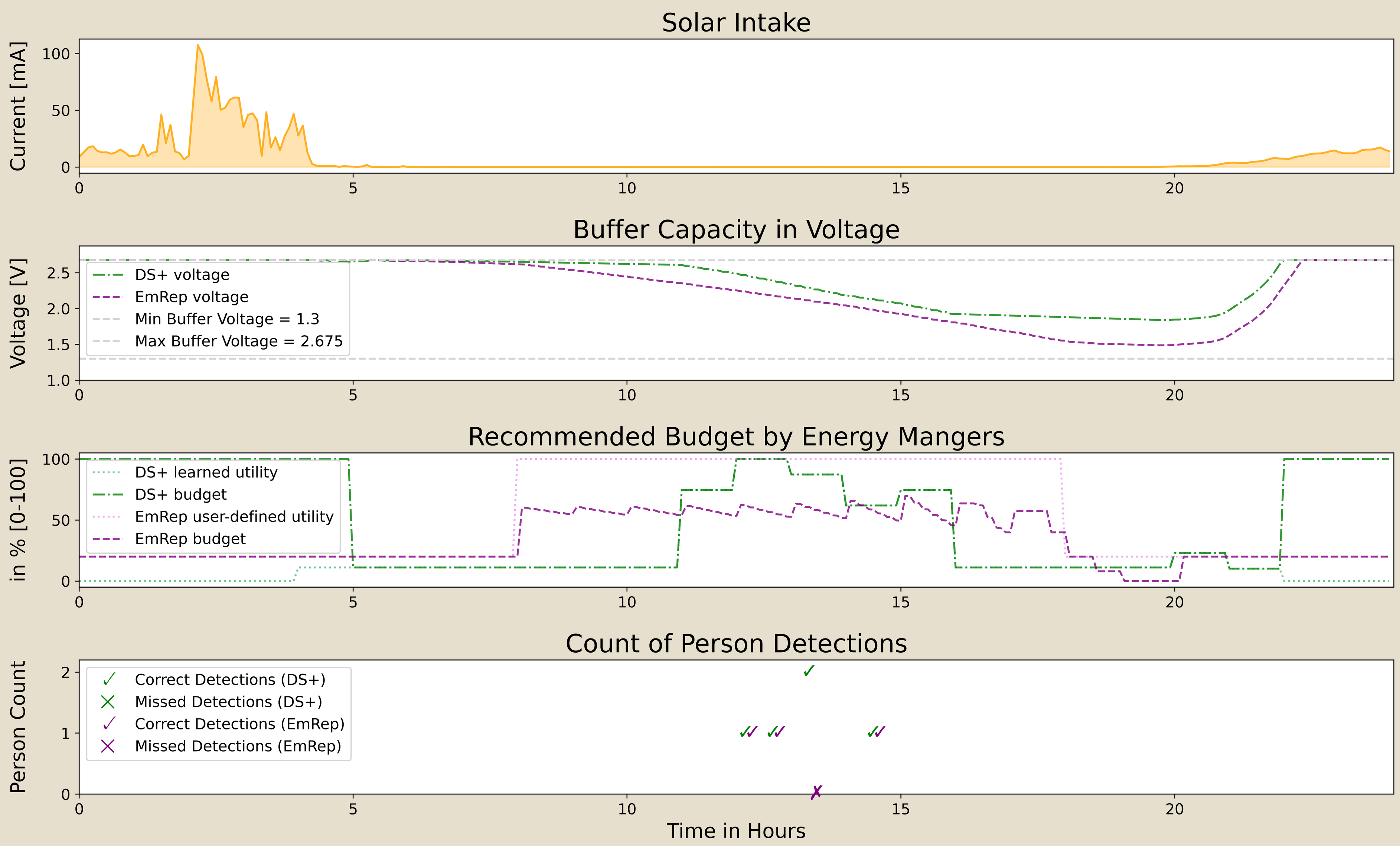
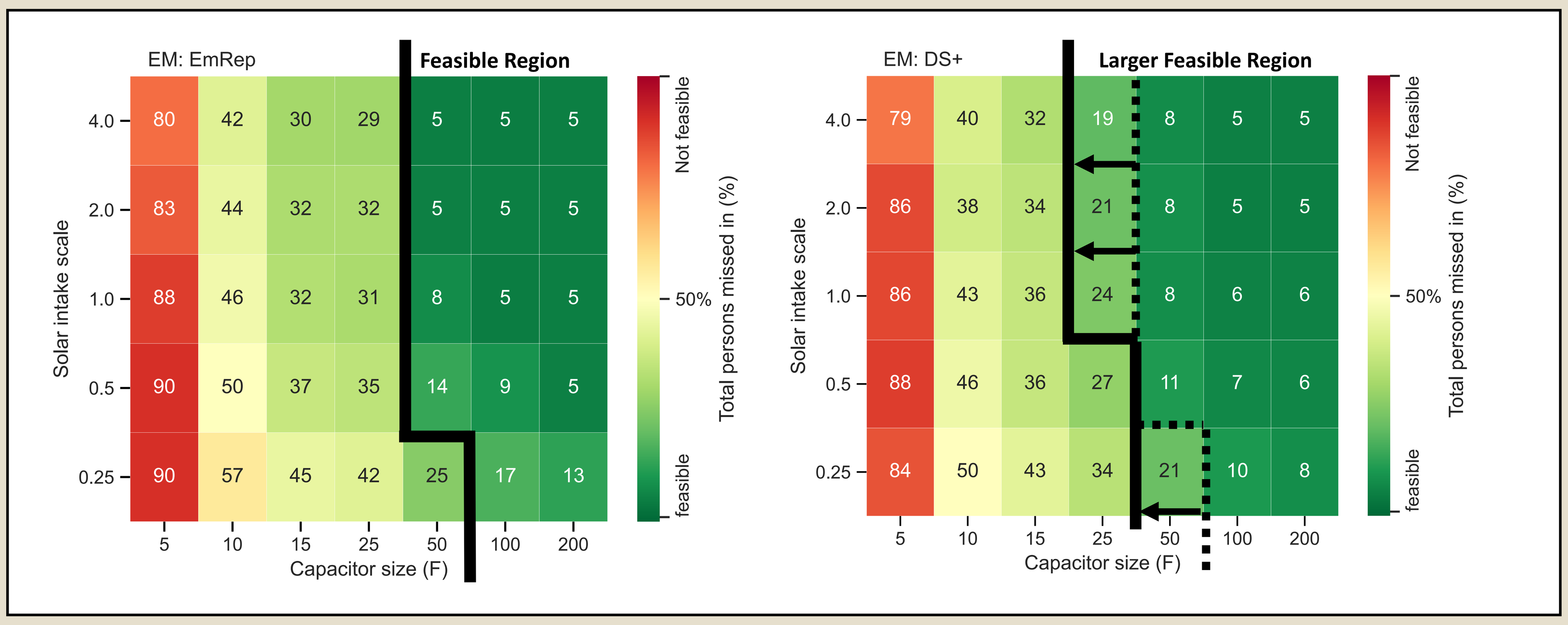


The architecture of the device used in simulations.



DS+ allocates more resources to slots where there's a higher learned likelihood of person presence.



Expansion of feasible configuration region: Person Missed Rates across Capacitor Sizes and Solar Intakes. Feasible regions highlight < 25% missed detections. **Left:** EmRep **Right:** DS+

Energy Harvesting Devices

Energy-harvesting wireless sensors require energy management due to volatile energy sources.

The majority of existing energy management (EM) planners [1,2] ensure energy-neutral operations and make a general assumption of constant energy consumption demand across all time slots.

Existing energy managers lack adaptability to changing utility requirements or often rely on manually defined utility profiles.

Proposed Energy Manager: DS+

Our proposed energy manager DS+, accounts for time-varying consumption based on learned application demands to maximize the application goal, which here is increasing the count of person detections.

It utilises the multi-armed bandit Upper Confidence Bound approach, to learn the utility profile without any prior data while keeping a balance of exploration and exploitation of time-slots under energy constraints.

This strategy prioritizes energy allocation during high detection periods, minimizing it during low detection phases to maximize the application goal but also dynamically adapts to application outputs over the time.

Feasibility Configuration Region

Our findings demonstrate that our proposed energy manager not only learns without any prior data but also extends the feasible configuration region compared to current state-of-the-art.

References

[1] Lars Hanschke and Christian Renner. 2022. EmRep: Energy management relying on state-of-charge extrema prediction. IET Computers & Digital Techniques 16, 4 (2022), 91–105.

[2] Christian Renner, Stefan Unterschütz, Volker Turau, and Kay Römer. 2014. Perpet- ual data collection with energy-harvesting sensor networks. ACM Transactions on Sensor Networks (TOSN) 11, 1 (2014), 1–45.