Emerging IoT technologies hold significant promises to improve quality of life; however, several challenges and resource restrictions arise in operating IoT deployments in a scalable, and resilient manner over time. Challenges include:

- Energy Constraints
- Failures
- Heterogeneity
- Variability
- Privacy
- Security

**Objectives**

- In our research, we aim to handle challenges caused by perpetual operations in different IoT platforms, such as mission-critical and assisted living deployments.
- Mission-critical systems are expected to operate 24/7 to monitor and detect critical events (health emergencies, gas leaks, fire etc.)
- Operational failures impact service availability and quality of service delivered by these solutions.

**Progress to Date**

**Studied Problem:**

- Energy efficiency for perpetual IoT platforms in an assisted living context.

**Unique characteristics to leverage:**

- IoT devices have heterogeneous power sources.
- IoT devices can be configured under multiple energy settings.
- Real time semantic knowledge of applications (Activities of daily living) can be derived.

**Aim:** Create an energy-efficient perpetual IoT system without loss of service quality.

**Methodology**

- Develop systems and applications to instantiate real world use cases to conduct measurement studies and gain insight into application needs, and system limitations.
- Use measurements to drive larger scale simulation studies.

**Experimental results**

Experimental studies with real world trace datasets indicated that our proposed algorithms were able to achieve more than 80% reductions in energy consumption, doubling the system-lifetime.

**Future Work**

We plan to develop techniques to integrate multiple functional and non-functional needs to operate perpetual IoT – focusing on interoperability, reliability and energy efficiency. This will require an in-depth understanding of how these requirements interact; we will design an intelligent middleware layer for heterogeneous device resource management in IoT deployments.

**Multinetworking and Perpetual IoT:**

- Addressing IoT energy efficiency challenges by leveraging IoT multiple network technologies, such as WiFi, Bluetooth, ZigBee and 2G/3G/4G cellular, .. etc.
- Depending on the application factors, such as range, data requirements, security, power demands and battery life will dictate the choice of one or some form of technology combination.

**Handling Failures in Perpetual IoT Deployments:**

- Determining IoT failures and how can we predict failure in IoT deployments.
- Develop techniques to track and monitor devices remotely. Use IoT device logs with sensor inputs, devices response, and detailed status updates back to a centralized controller with a data repository for analysis.

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