Motivations and Objectives

- **Motivations**
  - Data centers consume about 2% of the world’s energy supply so being able to improve their efficiency will help make a significant impact in the world carbon emissions.
  - Improving servers workload distribution and enhancing rack’s awareness of internal conditions can optimize the data centers’ power usage; thereby saving energy.

Goal

- Create an affordable open source sensory system that will allows data centers’ owners to have better control of their racks and increase energy efficiency.

Research Challenges

- Access internal server information (ie: temperature, CPU%) through the **IPMI** (Intelligent Platform Management Interface) protocol.
- Establish a seamless communication system between a server (IPMI), a Raspberry Pi (Python), and an Arduino microcontroller.
- Create conditions that the RGB LEDs can interpret from the thermal sensors via an Arduino.

Methodology

- Establish an I2C communication between the Raspberry Pi and the server in order to get the temperature, humidity, and pressure readings and thresholds and power monitoring.
- Load an Arduino UNO with drivers to communicate between the thermal sensors and the RGB LEDs in order to provide peripherals for monitoring the status of the rack.
- Feed all the sensory information into the Raspberry Pi and compare it with the thresholds provided by the server and adjust the LEDs color scale based on the conditions provided.

Results

- We were able to parallel the sensors using a multiplexer (I2C Expander) to reduce the number of occupied pins on the microcontrollers.
- We are able to simultaneously extract data from the sensors and servers and compare them in real time.
- We able to reduce the overall power consumption of the racks through tracking their workloads and power usage to maximize their run time efficiency.
- Implementing our system in a large data center can now provide operators with a visual heat map due to the changing color of the racks’ LEDs.

References


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