

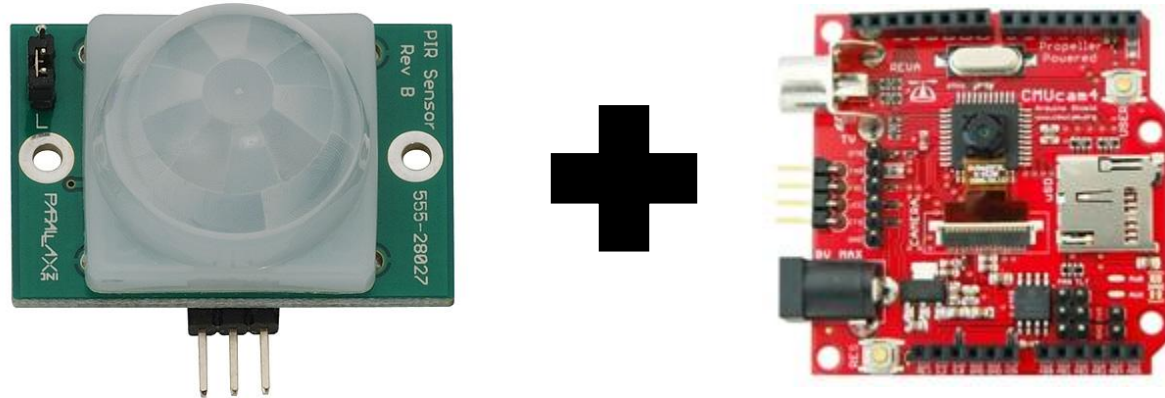
1. Goals

Overview

◆ Abstract

■ Current motion detectors that control lighting and building HVAC systems use passive infrared (PIR) sensors to detect the presence of a person in a room. However, PIR sensors cannot see small amounts of motion in a room and will turn the lights and HVAC system off on the occupants of a room who are sitting and working in the room. To remedy this problem I propose that a low-power computer vision system is used along with a PIR sensor to perform variable frame rate image differencing to detect the presence of people sitting and working in the room.

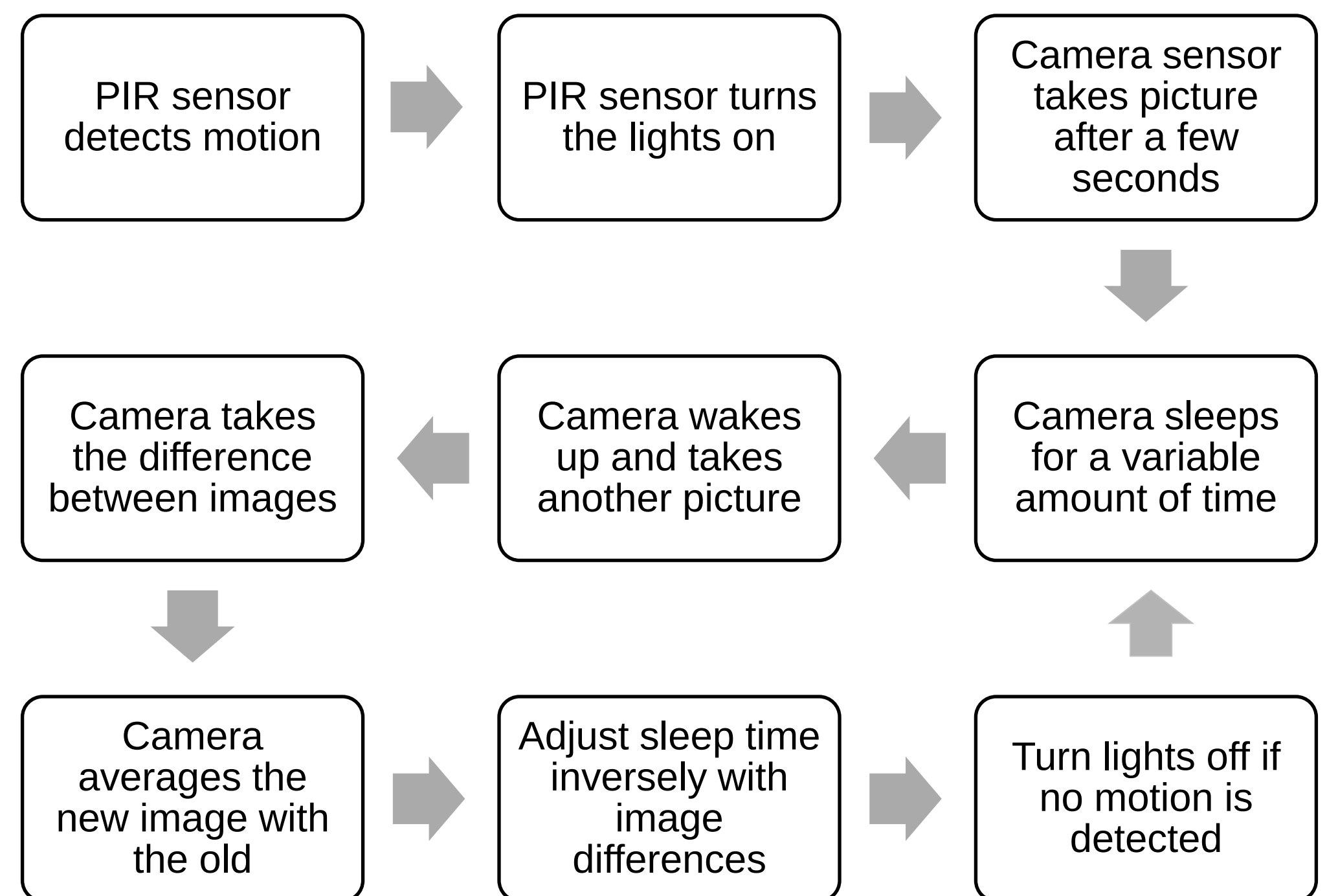
◆ Low-power, CMUcam4, PIR Sensor, inexpensive



2. System Overview

Big picture

◆ Theory of Operation



3. Approach

Details

◆ Goal

■ Prove that an embedded computer vision system like the CMUcam4 can detect motion like a PIR sensor and consume power comparable to a PIR sensor. In the future, the computer vision system will be able to detect motion better than a PIR sensor.

Summary

◆ Comparable Power Consumption

■ The CMUcam4 uses approximately **11.5 mA** of current when motion is detected on average resulting in a power consumption of about **57.5 mW** when powered by a 5V source. This is comparable to a standard PIR motion detector that uses **9.3 mA** of current when motion is detected resulting in a power consumption of about **46.5 mW** when powered by a 5V source.

◆ Effective Hysteresis Control

■ After detecting motion the CMUcam4 will keep the lights on for about 1 minute and 30 seconds before turning the lights off. Any small amount of motion will retrigger the CMUcam4.

References

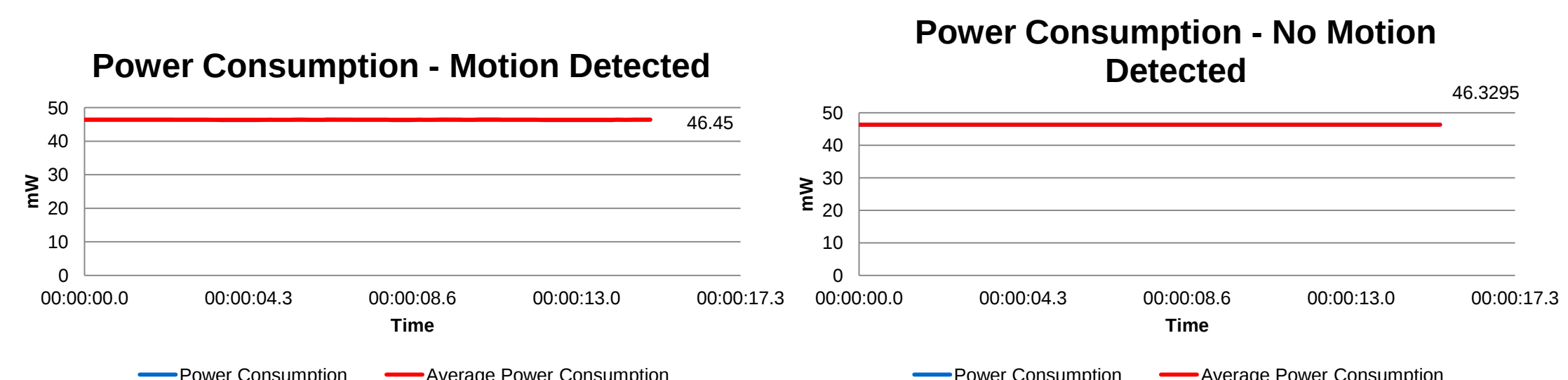
- ◆ C. Stauffer, W.E.L. Grimson, "Adaptive background mixture models for real-time tracking", published.
- ◆ M. Piccardi, "Background subtraction techniques: a review", unpublished.
- ◆ A. Verdant, A. Dupret, H. Mathias, P. Villar, L. Lacassagne, "Low Power Motion Detection with Low Spatial and Temporal Resolution for CMOS Image Sensor", published.
- ◆ K. Agyeman, "CMUcam4: Open Source Programmable Embedded Color Vision Sensor", unpublished.

4. Results

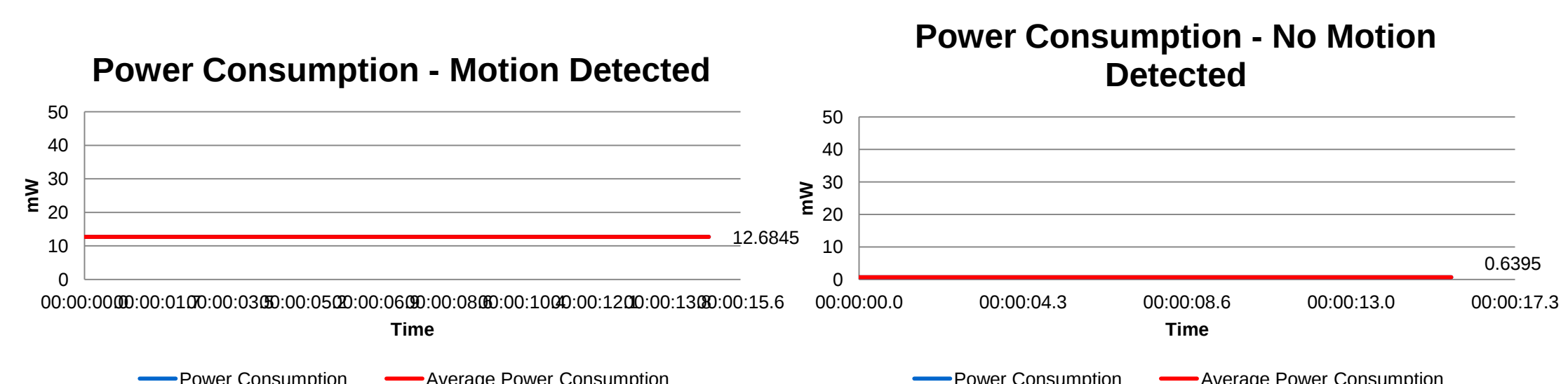
Plots

◆ Setup

■ PIR Sensor A – Tested for 20 seconds powered with 5V DC



■ PIR Sensor B – Tested for 20 seconds powered with 5V DC



■ CMUcam4 – Tested for 3 minutes powered with 5V DC

