Park of the Covenant
A Video Processing Solution for Zone-Based Traffic Monitoring

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Problem Statement

Heavily populated areas often necesitate the use of parking facilities for congestion control. We set out to develop a cost effective solution for monitoring occupancy of these facilities for the convenience of both managers and consumers.

Solution

By strategically deploying camera modules at entrance/exit points, we can monitor the traffic into and out of "zones" of occupancy.
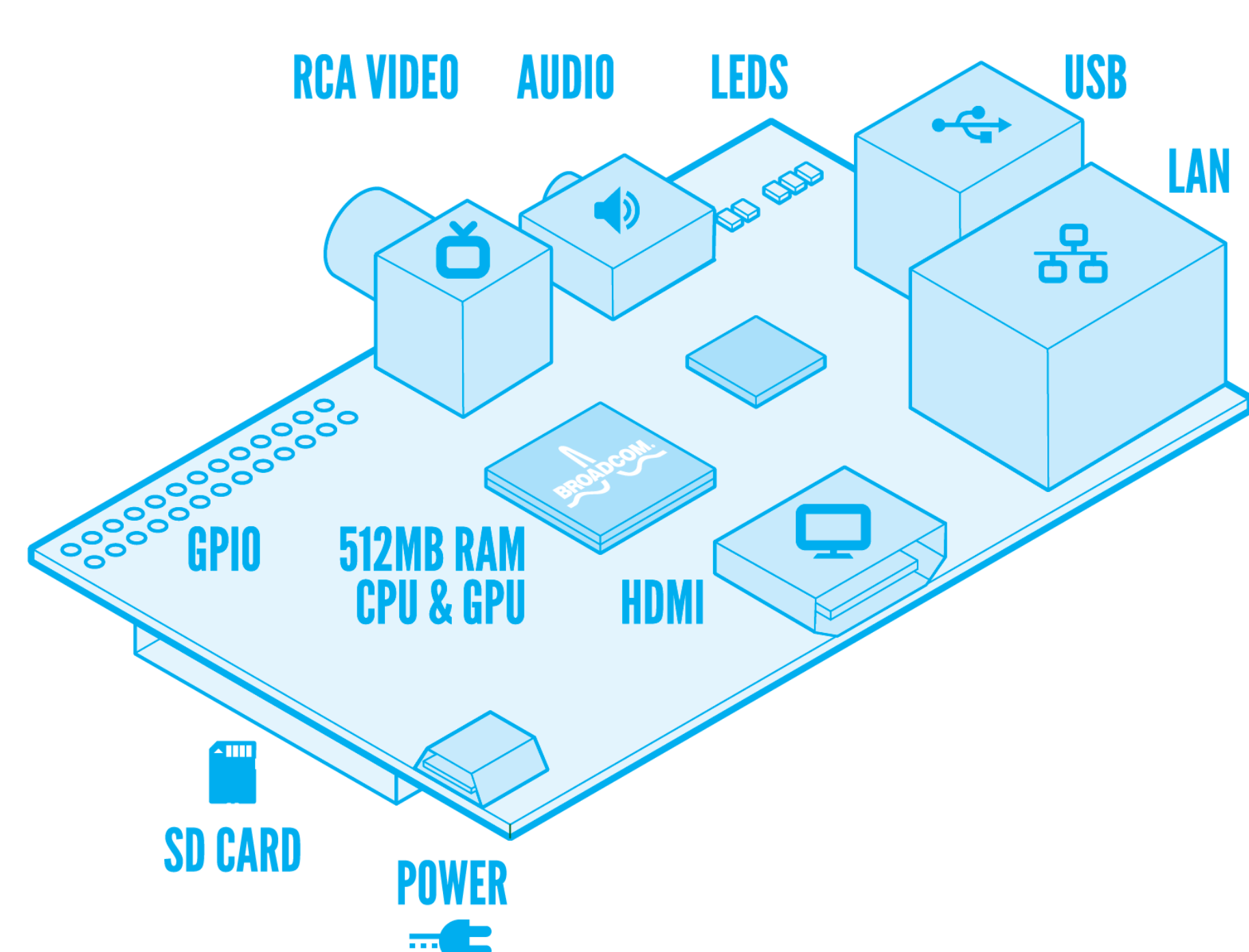
Monitoring Zone

Occupancy = cars in – cars out

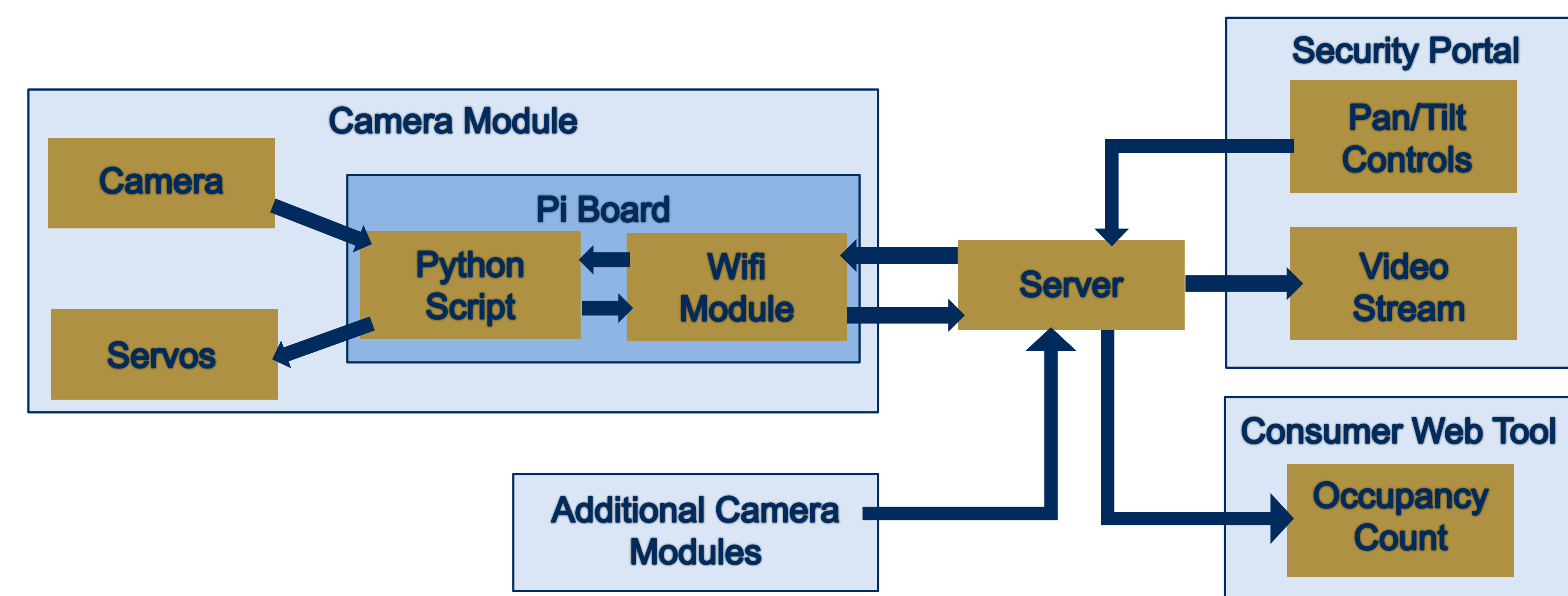By maintaining multiple zones of coverage, we can inexpensively monitor occupancy of large structures.
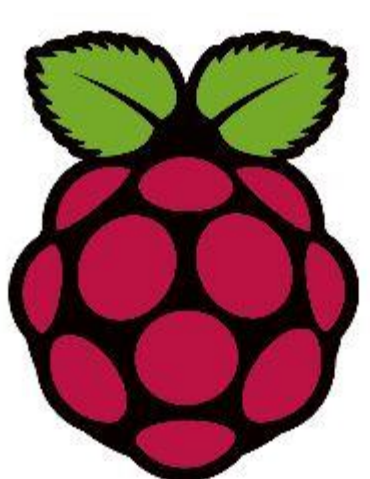
Raspberry Pi

Raspberry Pi serves as an inexpensive webcam option. At $55 for our entire implementation, it serves as a cost effective alternative to a webcam and board integrated with our localized video processing capabilities. By integrating these functionalities onto one device, we have far simplified the way in which we communicate with our server. The Pi's linux base allows for a large array of available resources and functionalities, allowing for the implementation of different solutions. This flexibility allows for more focus on difficult algorithmic and information management functionality.

RCA VIDEO AUDIO LEDS USB LAN
GPIO 512MB RAM CPU & GPU HDMI
SD CARD POWER

Project Overview

Security Portal
Camera Module
Camera
Pi Board
Python Script Wifi Module
Servos
Pan/Tilt Controls
Server
Video Stream
Additional Camera Modules
Consumer Web Tool
Occupancy Count

Video Processing Algorithm

In order to accurately detect objects moving across a camera module's field of view, we first capture a series of frames

We then create a binary image wherein pixels that have changed across the frames (those that are moving) are seen as white, and background objects (static objects) are displayed as black. Next, we use blob detection to track these objects motion and discern their direction.

Next, we use blob detection to isolate and identify unique moving objects, and track their locations across multiple frames to determine the direction of their motion.
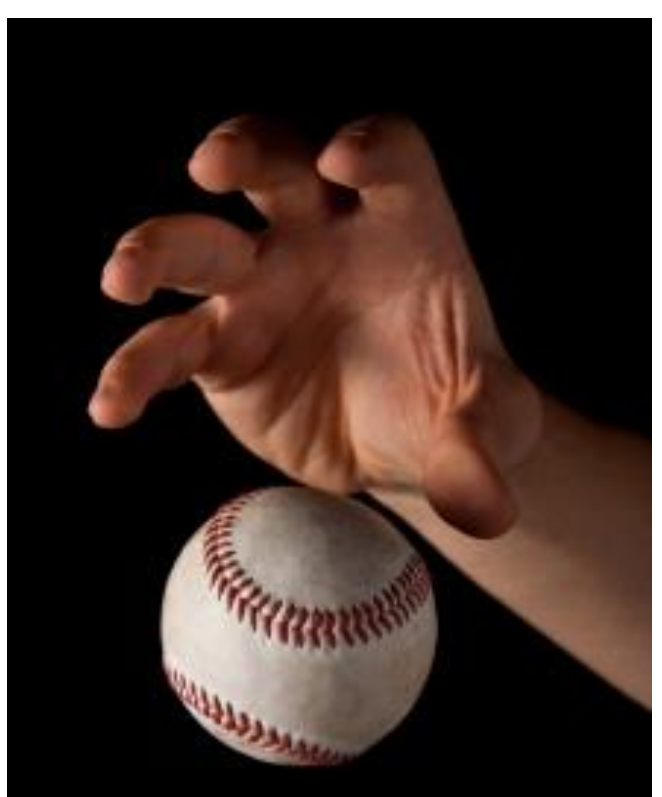
Internet-side Functionality

Node.js was chosen as the platform for the development of our web application. Node.js is built on Google Chrome's JavaScript runtime and is a modern tool that is currently used by many in the industry.

MongoDB was used as the database to record all instances of traffic passing into or out of a zone. MongoDB is also based on JavaScript and interacts well with Node.js. Each instance of traffic passing a camera is sent to the database as a JSON object which records which camera saw the event and the direction of movement (indicated as +1 or -1).