Building Machine Vision Applications using OpenMV

Class 1: Introduction to Machine Vision and OpenMV

June 8, 2020

Jacob Beningo

DesignNews

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Course Overview

Topics:

- **Introduction to Machine Vision and OpenMV**
- Writing our First OpenMV Application
- Working with the OpenMV I/O
- Utilizing Machine Learning to Detect Objects
- Designing a Machine Vision Application

The Lecturer – Jacob Beningo

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- EDN : Embedded Basics

ARM Connected Community

Consulting

- Advising
- Coaching
- Content
- Consulting
- Training

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Jacobs CEC Courses

CEC 2013 – 2016

- Fundamentals of Embedded Software (2013)
- Mastering the Software Design Cycle (2014)
- Python for Embedded Systems(2014)
- Software Architecture Design (2014)
- Baremetal C (2015)
- Mastering the ARM Cortex-M Processor (2015)
- Writing Portable and Robust Firmware in C (2015)
- Design Patterns and the Internet (2015)
- Bootloader Design for MCUs (2016)
- Rapid Prototyping w/ Micro Python (2016)
- Debugging (2016)
- Professional Firmware (2016)

CEC 2017 - 2018

- API's and HAL's February 2017
- Baremetal to RTOS April 2017
- Designing IoT Sensor Nodes July 2017
- From C to C++ October 2017
- Connecting Edge Devices (March 2018)
- Building an IoT Connected PLC (April 2018)
- Securing IoT Devices using Arm TrustZone (Nov 2018)
- Minimizing Defects (Dec 2018)

CEC 2019

- Machine Learning for Embedded (April 2019)
- Designing Embedded Systems using MicroPython
- Launching a Product (Nov 2019)

CEC 2020

- Getting Started with Secure Software
- Building Machine Vision Applications using OpenMV
- Techniques for Interfacing with Modern Sensors (October)
- Designing Embedded Systems using the ESP32 (December)

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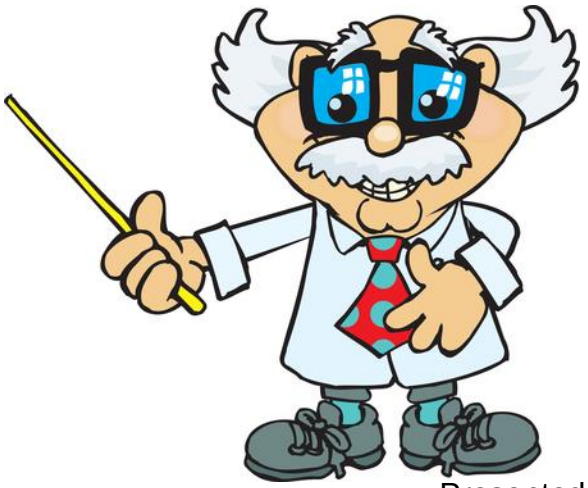
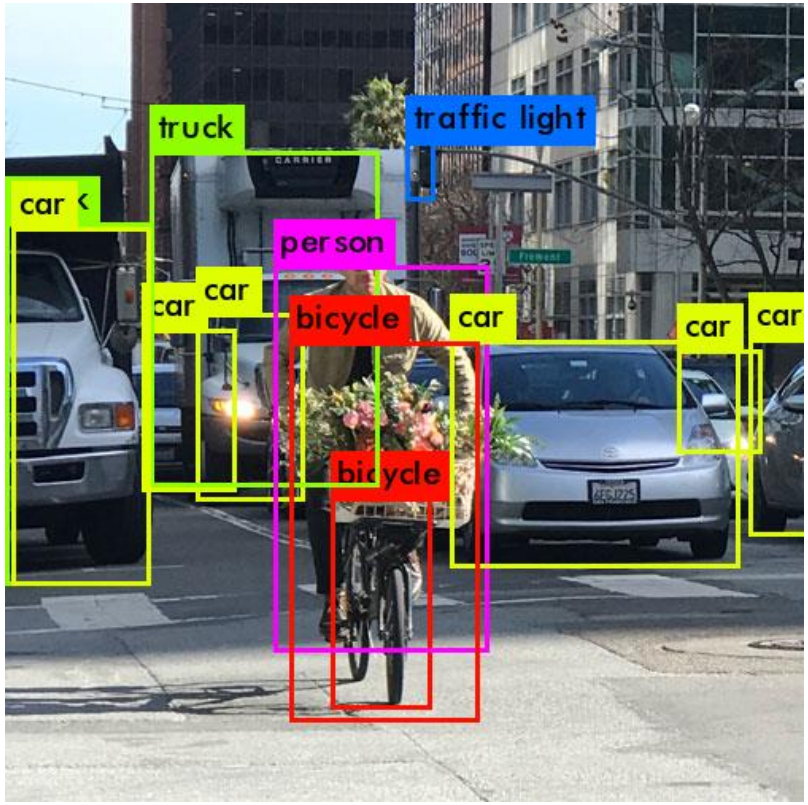
Session Overview

- Machine Vision in Embedded
- Machine Vision Architectures
- OpenMV Cam H7
- OpenMV IDE



Presented by:

Machine Vision in Embedded



Source: Papers with Code

Source: Target.com

Machine Vision

Image Source:
Kwiksource.com

Image Source:
Safewise

Machine Vision

Image Source:
Kwiksource.com

Image Source:
Safewise

Machine Vision

Source: aimee.io

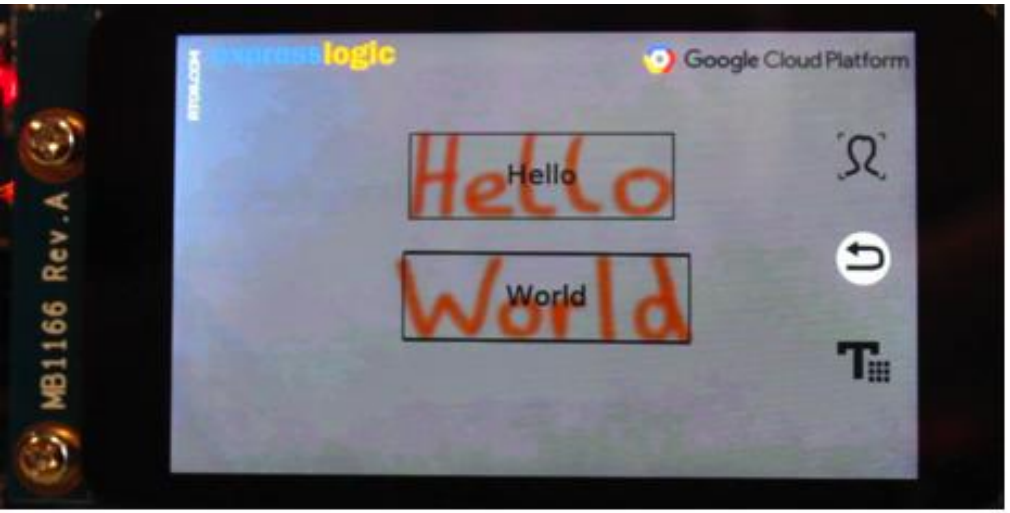
Machine Vision Architectures

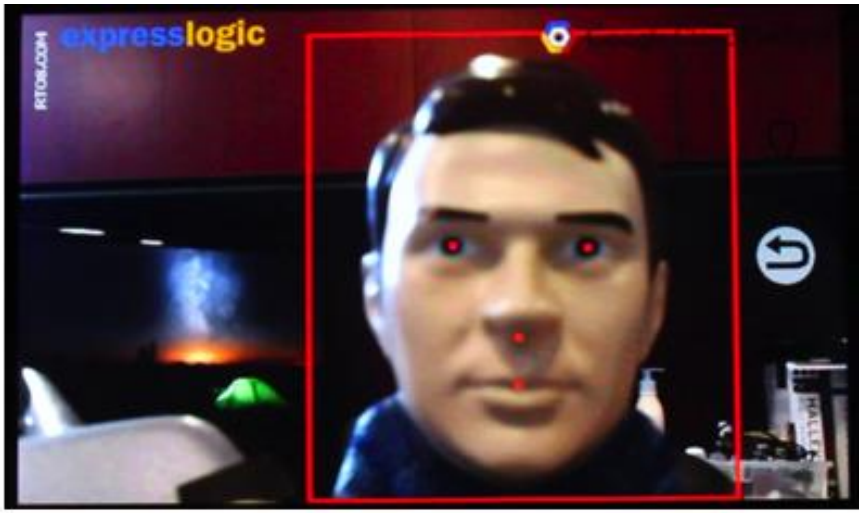
Machine Vision Architectures

What can an online API do?

- Insights from images
  - 2 Cats
  - 1 Dog
  - 1 Squirrel
- Extract text
  - Optical Character Recognition (OCR)
- Face detection
- Content moderation
  - SafeSearch

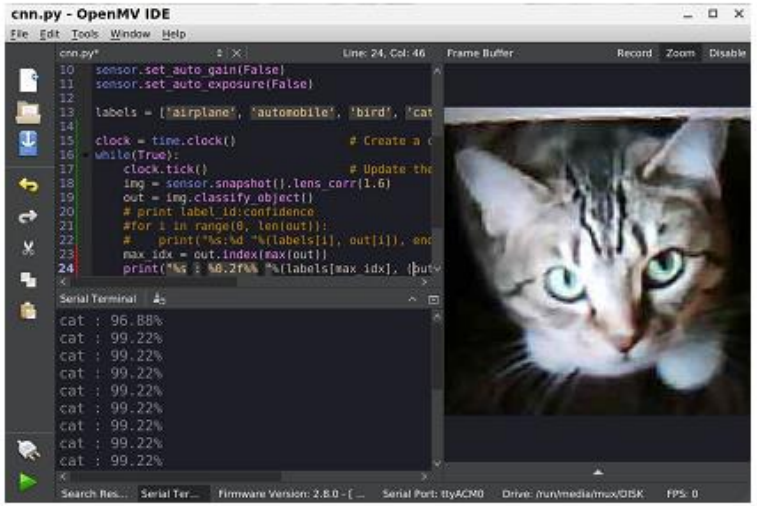
Machine Vision Architectures






```
Output:                                                    Log file: Off
DHCP client running...
IP address: 10.0.0.221
Network mask: 255.255.255.0
Google Vision API is ready
DNS Lookup for GOOGLE APIs Domain:vision.googleapis.com
GOOGLE APIs Domain IPv4 address: 172.217.0.10
TCP session established.
TLS session established.
Text[(258, 111), (541, 111), (541, 203), (258, 203)]: Hello
Text[(252, 240), (558, 242), (558, 336), (252, 334)]: World
```

Machine Vision Architectures



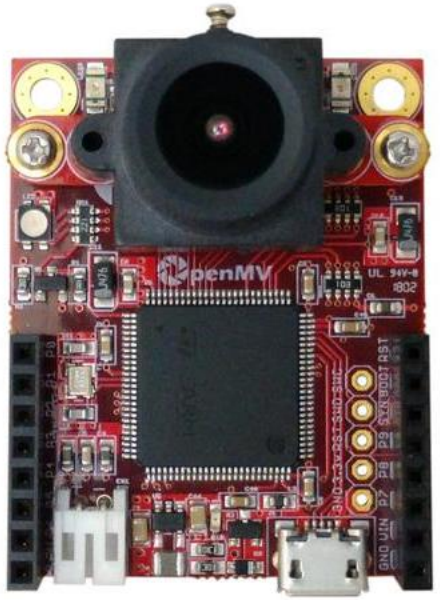
[OpenMV Cam with a Cortex-M7]

[Video to Watch]

OpenMV Cam H7

OpenMV is a project that brings machine vision into a simple Arduino like environment for “simple” applications.

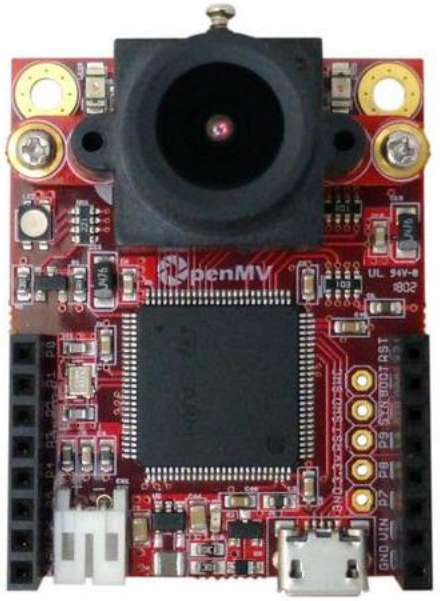
- Can write scripts in Python
- Expandable I/O for interfacing
- Built-in camera module
- Expandable camera options
- Custom IDE for developing and deploying scripts



Source: openmv.io

OpenMV Cam H7

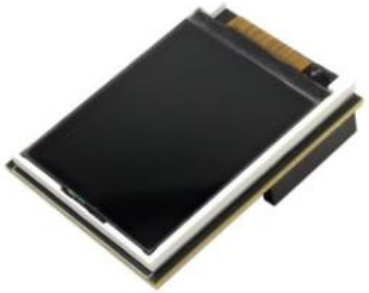
- Arm Cortex-M7 Processor
  - STM32H743VI
  - 400 MHz
  - 1MB RAM
  - 2 MB Flash
- OV7725 image sensor
  - 640x480 16-bit RGB565 @ 60 FPS
  - 640x480 8-bit Grayscale images
- 2.8 mm lens



Source: openmv.io

OpenMV Cam H7 Expansions

LCD



Wi-Fi

Servo

Pan and Tilt

Motor

Flit Camera Adapter

Sources:
openmv.io

OpenMV Cam H7 Availability

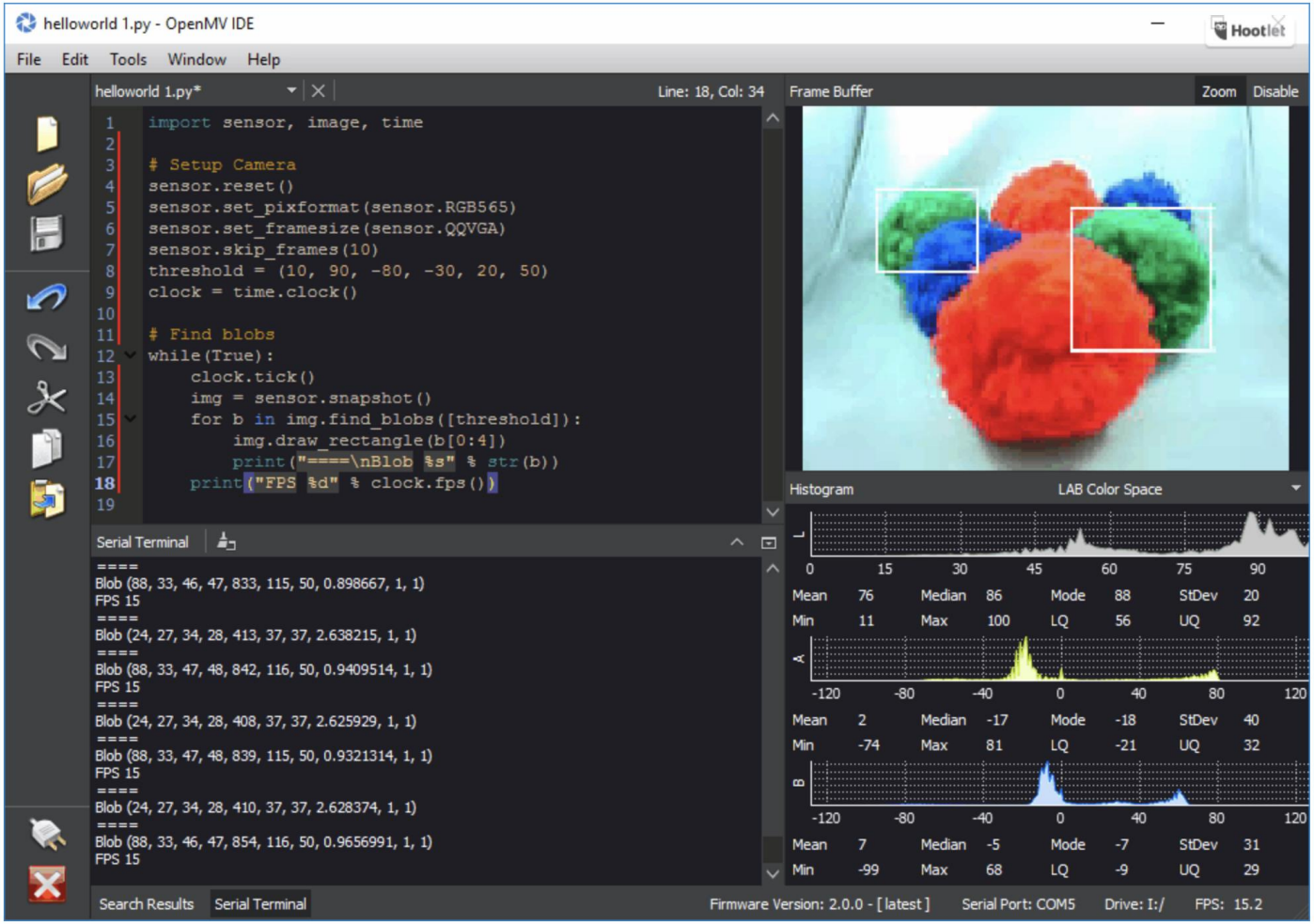
Source: openmv.io

OpenMV Cam H7 – Getting Started

- Use a screwdriver to remove the two-lens mount screw from the lens mount on your OpenMV Cam.
- Apply some isopropyl alcohol to a small part of the cloth.
- Rub the wet part of the cloth on the camera IC gently. Any dirt spots on the camera IC will be microscopic to the human eye so just try to generally rub down the top of the camera IC. Note that the top of the camera IC is glass.
- After cleaning the camera IC make sure the alcohol has evaporated completely and that no cloth strands were left behind. Note that we're using isopropyl alcohol versus water since isopropyl alcohol evaporates quickly and doesn't leave anything behind.
- Use the screwdriver to re-attach the lens mount. Make sure that the set screw on the lens mount points off the top/back of the OpenMV Cam.

Source: openmv.io

The OpenMV IDE



Source: openmv.io

Additional Resources

- Beningo.com
  - Blog, White Papers, Courses
  - Embedded Bytes Newsletter
    - http://bit.ly/1BAHYXm
- OpenMV.io

From www.beningo.com under

- Blog > CEC – Building Machine Vision Applications using OpenMV