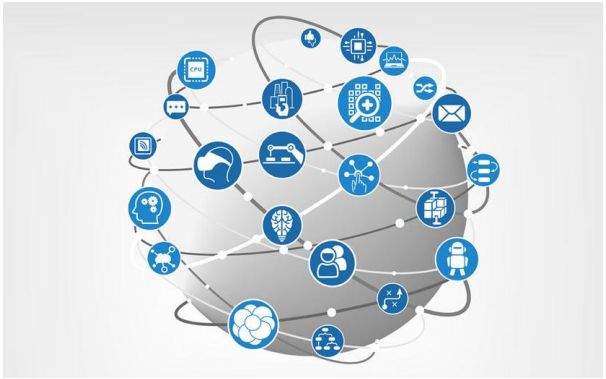
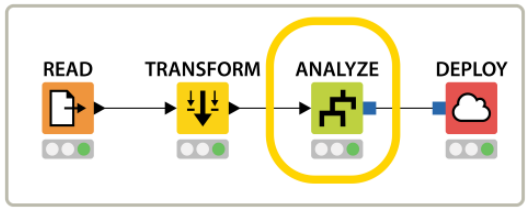
Predictive Analytics and Machine Learning Basics

Class 5: Machine Learning Lab – Google AIY Vision Kit





July 20, 2018

Don Wilcher

DesignNews

Presented by:

CEC CONTINUING EDUCATION CENTER

Digi-Key ELECTRONICS

Class 5: Machine Learning Lab – Google Vision Kit

Agenda

- What is Image Recognition?
- Lab Project: Build Google Vision Kit: An Intelligent (Smart) Camera.

What is Image Recognition?

- The ability of software to identify objects, places, people, writing and actions in images.
- Computers can use machine vision technologies in:
  a. combination with a camera
  b. artificial intelligence.

Source:
https://searchenterpreiseal.techtarget.com/definition/image-recognition

What is Image Recognition?. . .

- The process of identifying and detecting an object or a feature in a digital image or video.
- The method is used in many applications likes:
  a. systems for factory automation
  b. toll booth monitoring
  c. security surveillance
  d. object detection

Source:
https://www.mathworks.com/discovery/image-recognition.hmtl

What is Image Recognition?. . .

Image recognition typically uses algorithms like:

a. optical character recognition.

b. pattern matching and gradient matching.

c. face recognition.

c. license plate matching.

d. scene identification or scene change detection.

Source:

https://www.mathworks.com/discovery/image-recognition.hmtl

What is Image Recognition?. . .

- Image recognition uses a neural network called a *Convolutional Neural Network* or *Conv Nets* for short.
- The Conv Net uses many identical copies of the same neuron.
- The network is capable of having a large amounts of neurons, thereby capable of expressing large models through computations.

Source:

https://colah.github.io/posts/2014-07-Conv-Nets-Modular/

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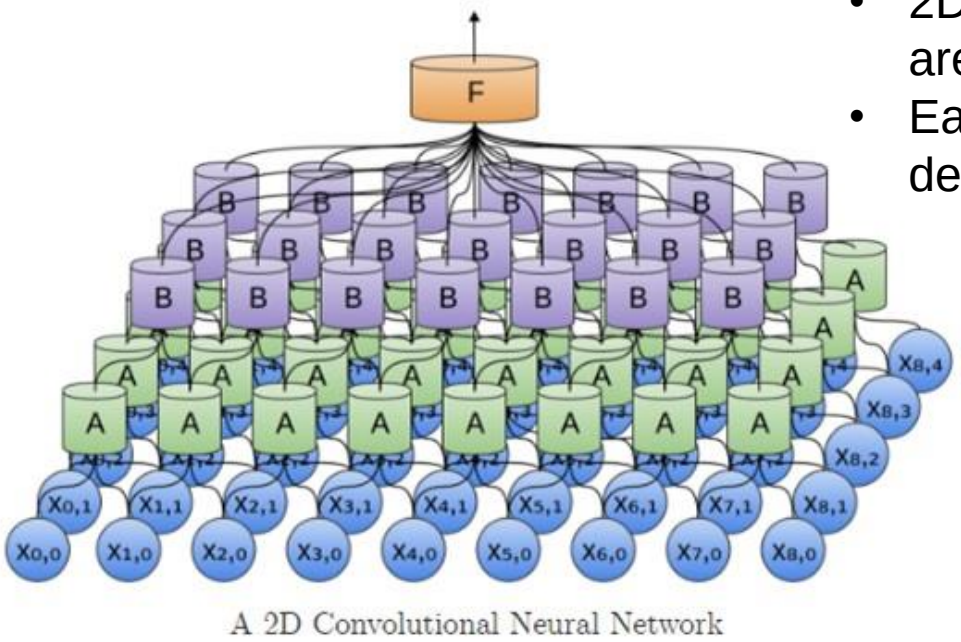
https://colah.github.io/posts/2014-07-Conv-Nets-Modular/

What is Image Recognition?. . .

- Each layer of a Conv Net allows higher level, more abstract features to be detected.



A 2D Convolutional Neural Network

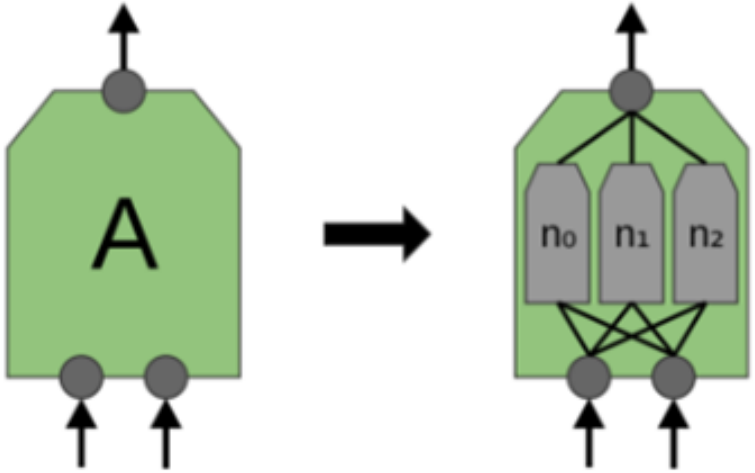
- 2D Convolutional Neural Networks are used to recognize images
- Each layer is responsible for detecting image features.

Source:

https://colah.github.io/posts/2014-07-Conv-Nets-Modular/

What is Image Recognition?. . .

- A multitude of neurons in parallel receiving the same inputs provides specific computational based image features.



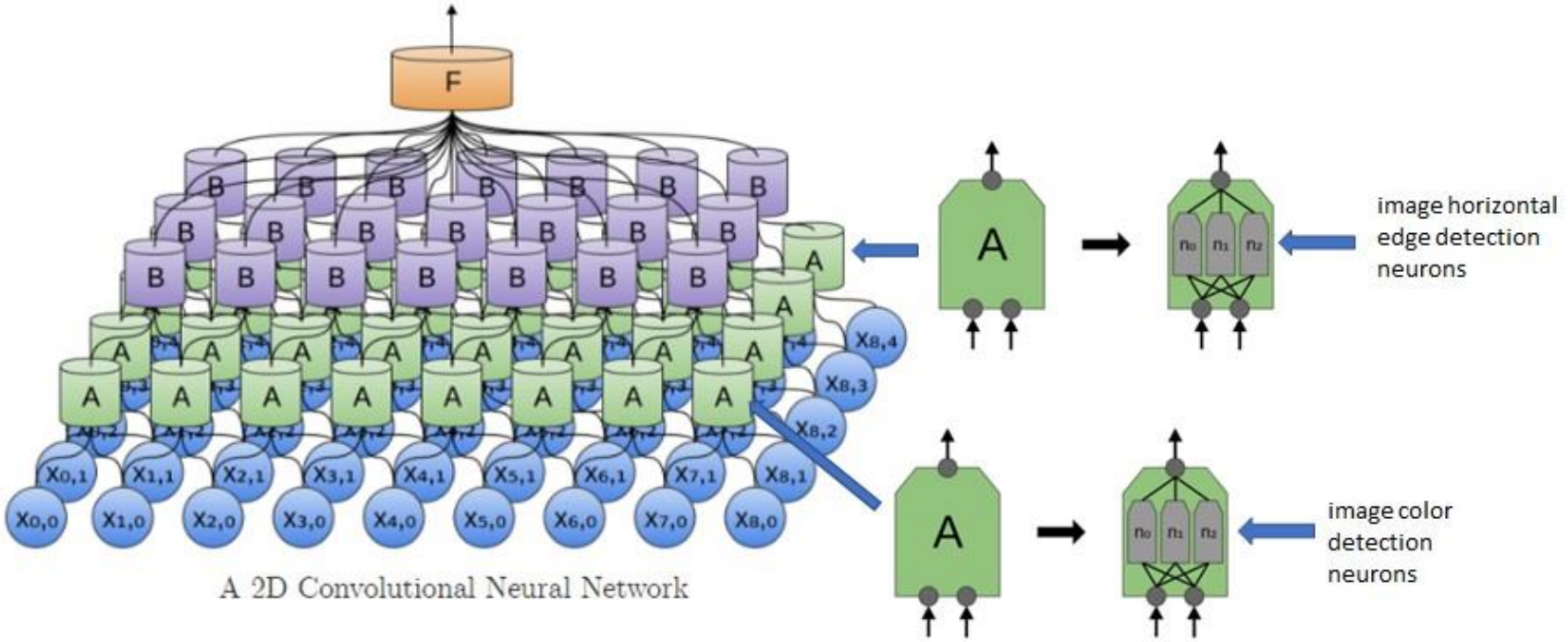
- Specific image features like a horizontal or vertical edge is detected.
- Color features like green or red can be detected using parallel neuron configurations.

Source:

https://colah.github.io/posts/2014-07-Conv-Nets-Modular/

What is Image Recognition?. . .

Conv Net uses an array of parallel neurons to detect image features. The more neurons the better the image features can be detected.



A 2D Convolutional Neural Network

Source:

https://colah.github.io/posts/2014-07-Conv-Nets-Modular/

Question 1:

Computers can use machine vision technologies in_____

Lab Project: Build a Google Vision Kit: The Intelligent Camera

Lab Project Objectives:

a. Learn about Intelligent Cameras.

b. Learn how to build an Intelligent Camera.

   i. The Intelligent Camera Build and Test Workflow

c. Learn how to execute the image classification camera demo.

Lab Project: Build a Google Vision Kit: The Intelligent Camera

What is an Intelligent (Smart) camera?

a. A machine vision system.

b. Able to extract application specific information from the captured images.

c. A built in image-sensor in the housing of an industrial video camera.

d. It has a communication interface for connecting to PLCs, relays, and other electromechanical actuators.

Lab Project: Build a Google Vision Kit: The Intelligent Camera

What is an Intelligent (Smart) camera?

Question 2:

True or False: 3D Convolutional Neural Networks are used to detect images ?

Lab Project: Build a Google Vision Kit: The Intelligent Camera

The Vision Bonnet

Source:
https://medium.com/@aallan/hands-on-with-the-aiy-projects-vision-kit-12677aa7e743

Lab Project: Build a Google Vision Kit: The Intelligent Camera

The Vision Bonnet

intel Movidius **Vision Processing Unit (VPU)**

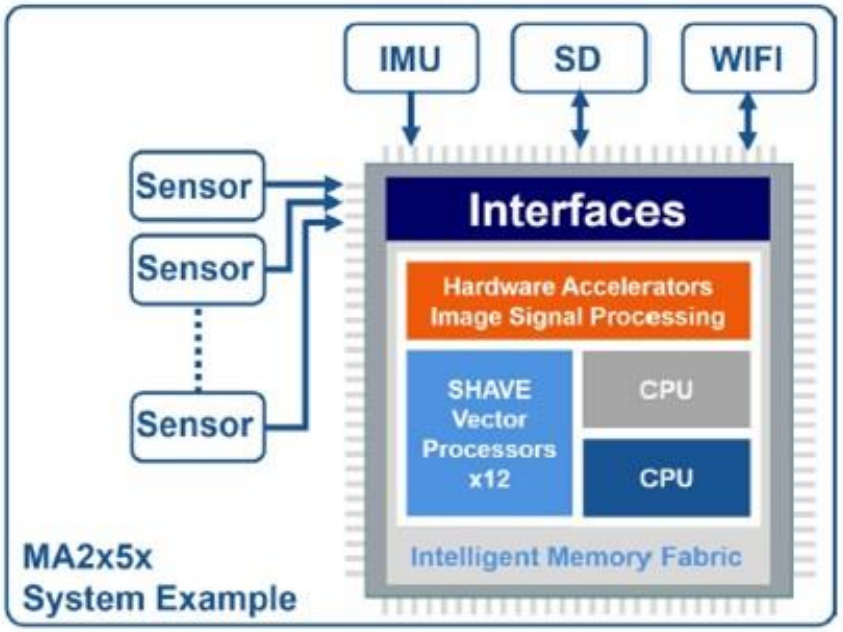
TARGET APPLICATIONS

- Deep Neural Network-based Classification
- Pose Estimation
- 3D Depth
- Visual Inertial Odometry (Navigation)
- Gesture/Eye Tracking and Recognition

EXAMPLE PRODUCT CATEGORIES

- AR/VR Head Mounted Displays (HMDs)
- Drones/UAVs
- Security/Surveillance Cameras
- Service Robotics

Inertial Measurement Unit (IMU)



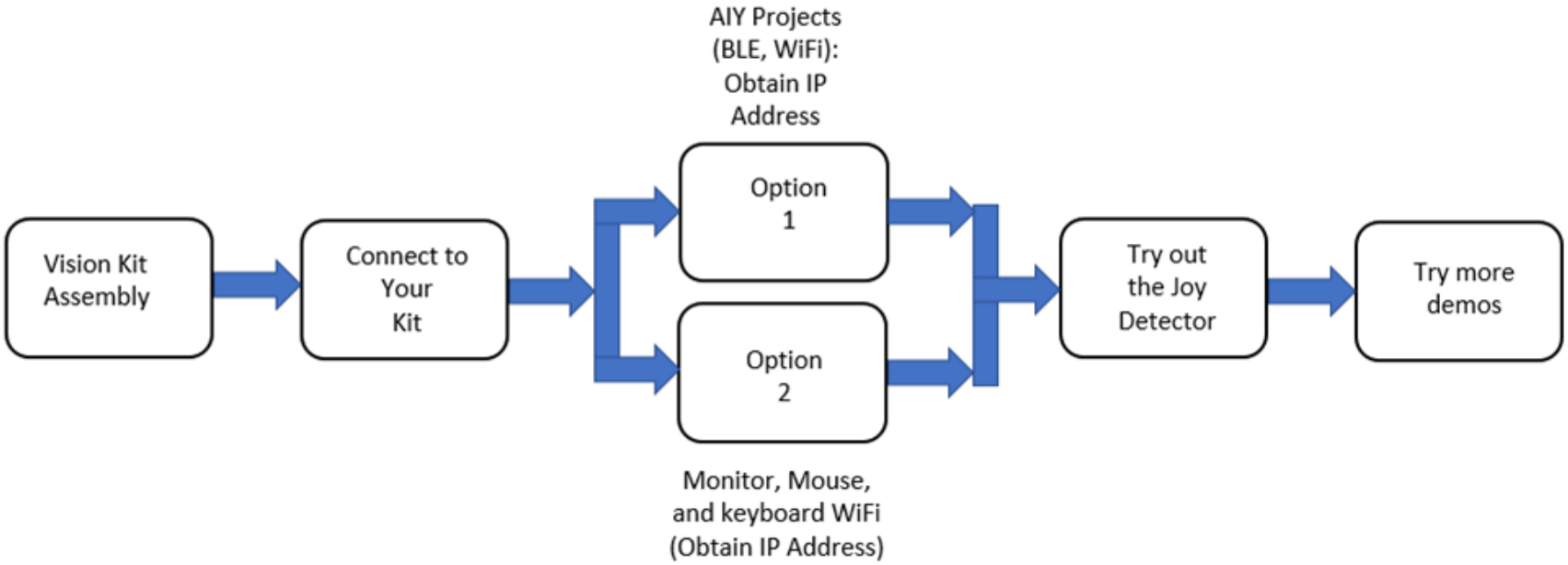
Source:

http://movidius-uploads.s3.amazonaws.com/1463156689-2016-04-29_VPU_ProductBrief.pdf

Lab Project: Build a Google Vision Kit: The Intelligent Camera

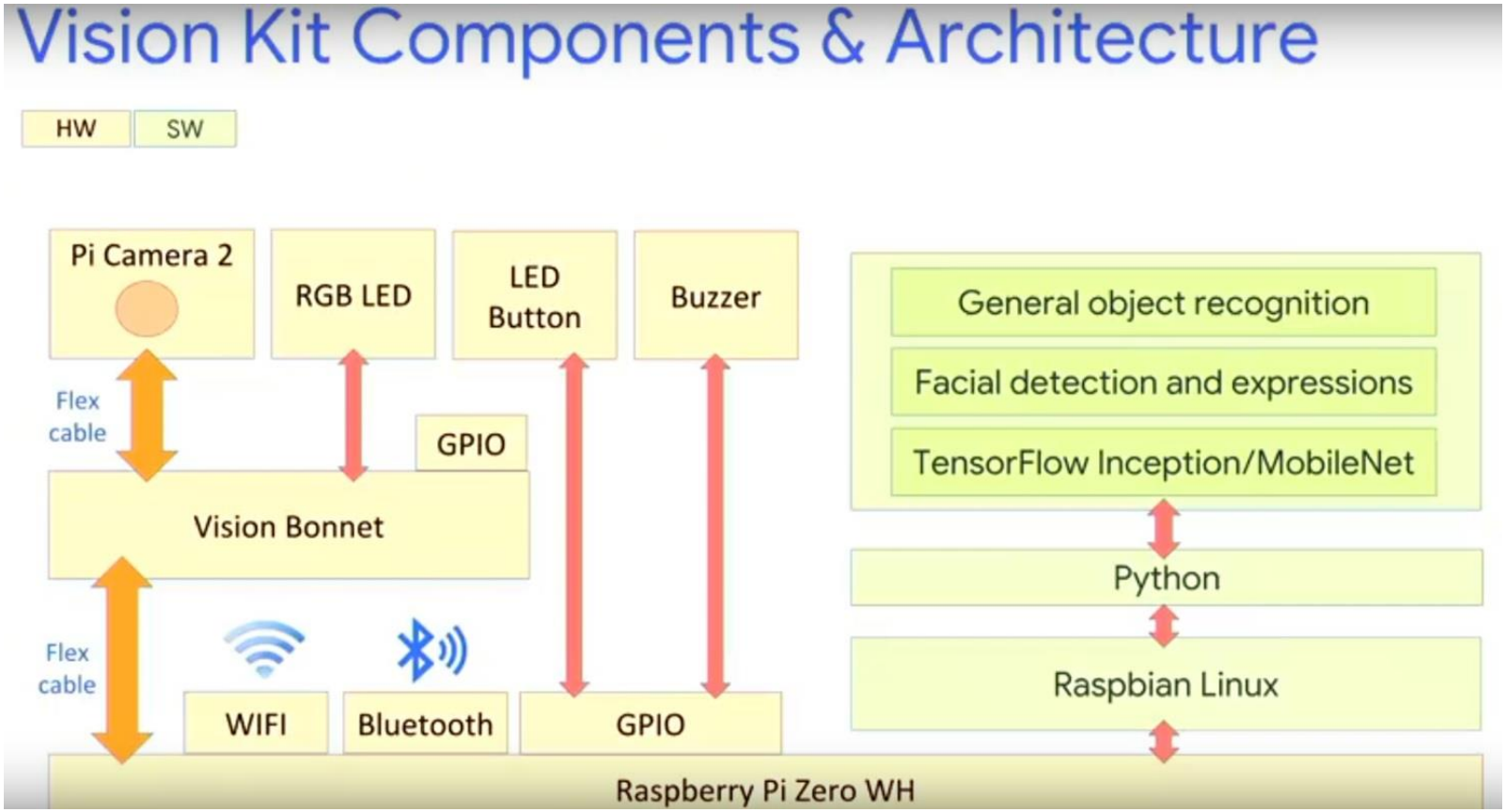
Intelligent (Smart) Camera Build Workflow

Google AIY Vision Kit



Lab Project: Build a Google Vision Kit: The Intelligent Camera

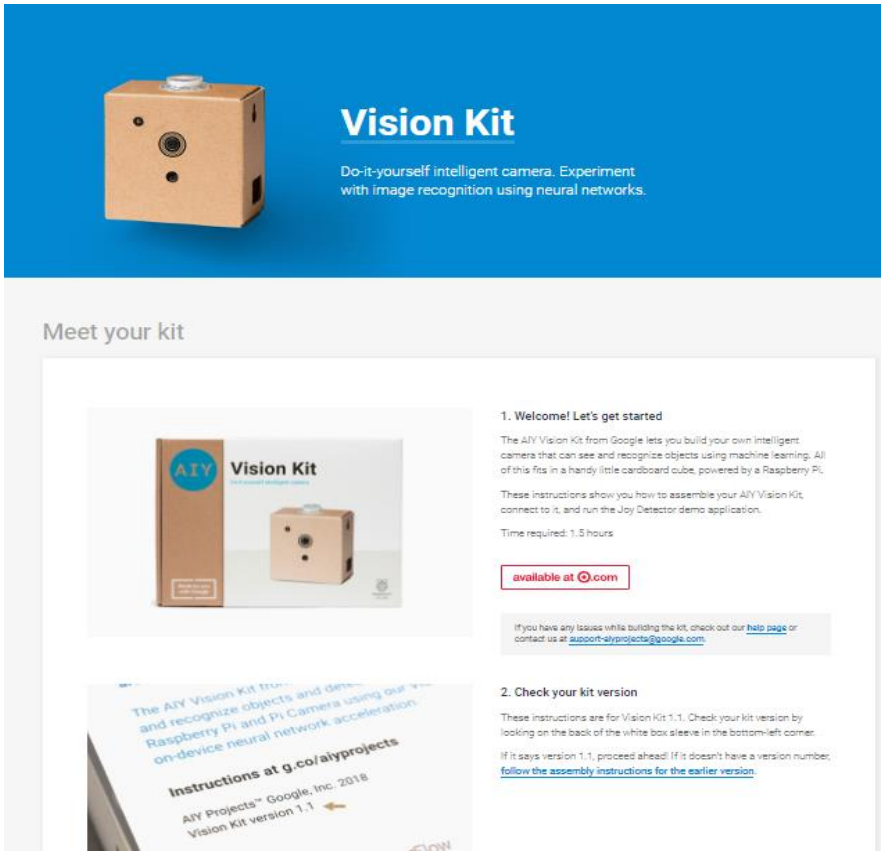
Intelligent Camera Architecture



Source:
https://www.youtube.com/watch?v=dE2T6ZxcAiQ

Lab Project: Build a Google Vision Kit: The Intelligent Camera

Intelligent Camera Build Workflow



Assembly information pages will be referenced from the Makers guide document.

Source:
https://aiyprojects.withgoogle.com/vision/

Question 3 :

The Vision Bonnet uses what type of neural network for classification?

Lab Project: Build a Google Vision Kit: The Intelligent Camera . . .

Intelligent Camera Build Workflow

Google AIY Vison Kit

List of materials

Source:
https://aiyprojects.withgoogle.com/vision/

Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

Google AIY Vision Kit

IN YOUR KIT

1	Voice Bonnet	(×1)	6	Button Nut	(×1)
2	Raspberry Pi Zero WH	(×1)	7	Button Harness	(×1)
3	Speaker	(×1)	8	Standoffs	(×1)
4	Micro SD Card	(×1)	9	Micro USB Cable	(×1)
5	Push Button	(×1)	10	External Box	(×1)

Source:

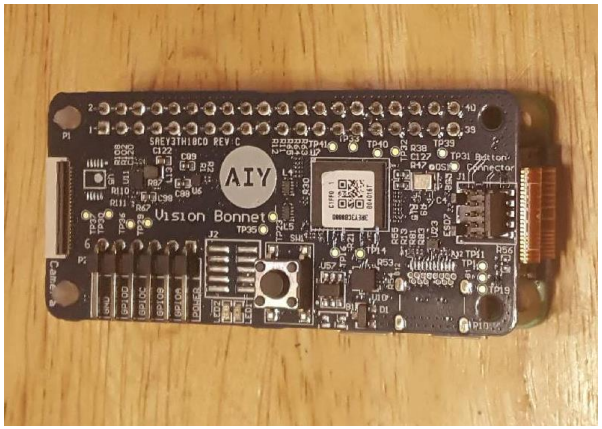
https://aiyprojects.withgoogle.com/vision/

Question 4 :

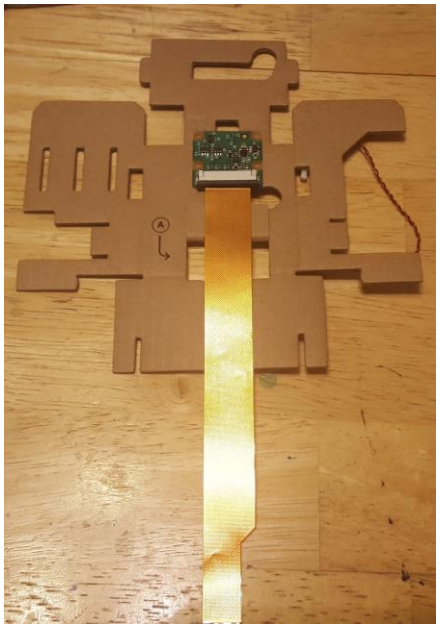
On slide 19 what object recognition, detection and expressions components are used in the Vision Kit Components and Architecture?

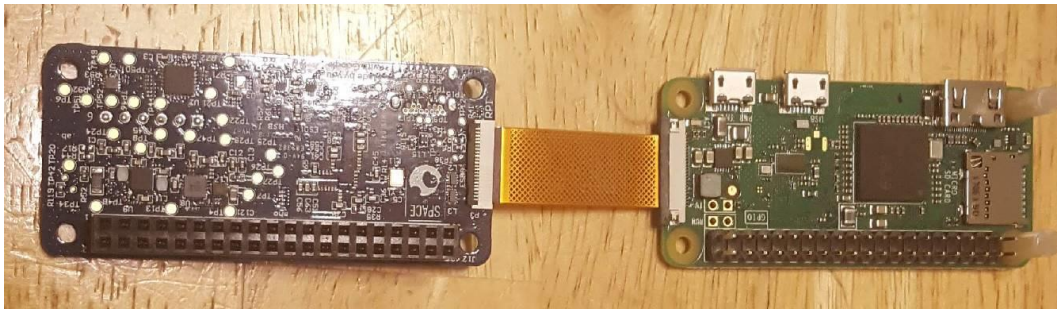
Lab Project: Build a Google Vision Kit: The Intelligent Camera

Intelligent Camera Build Workflow



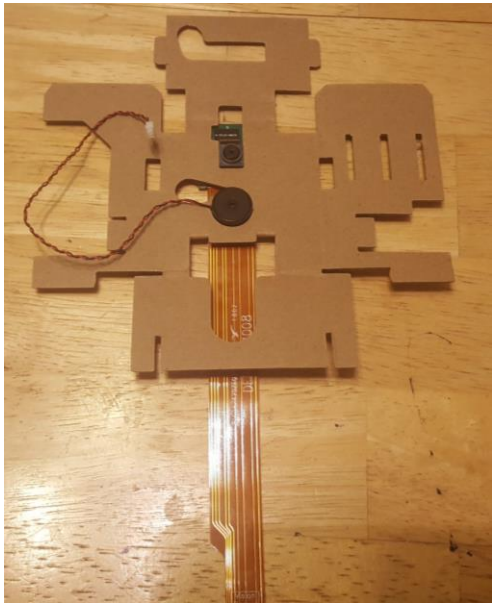
Vision Kit Assembly

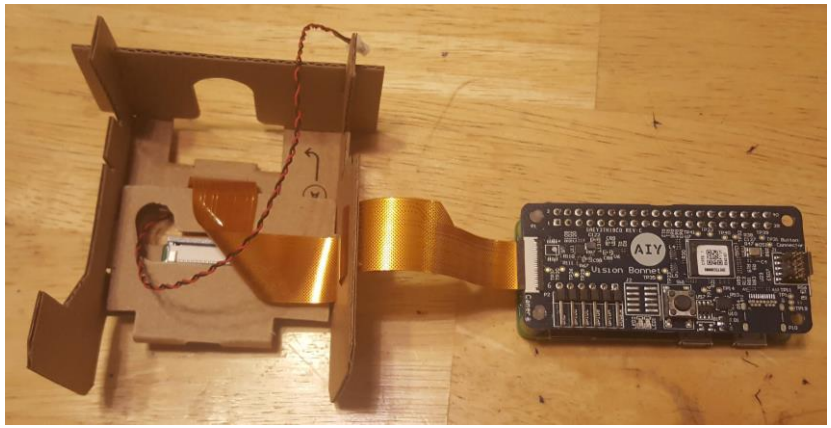




Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

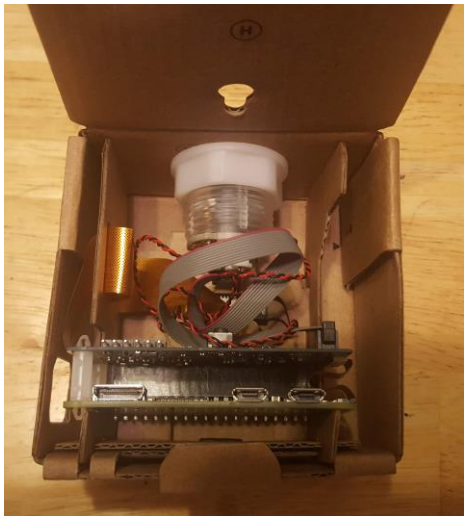




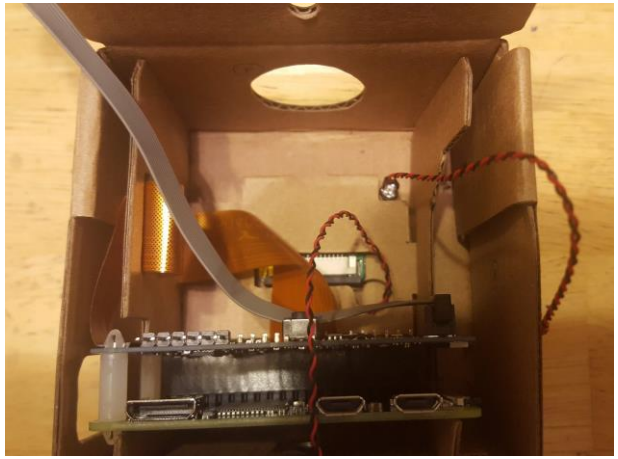
Vision Kit Assembly

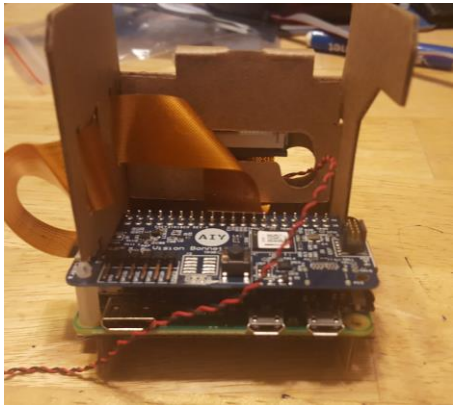
Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow



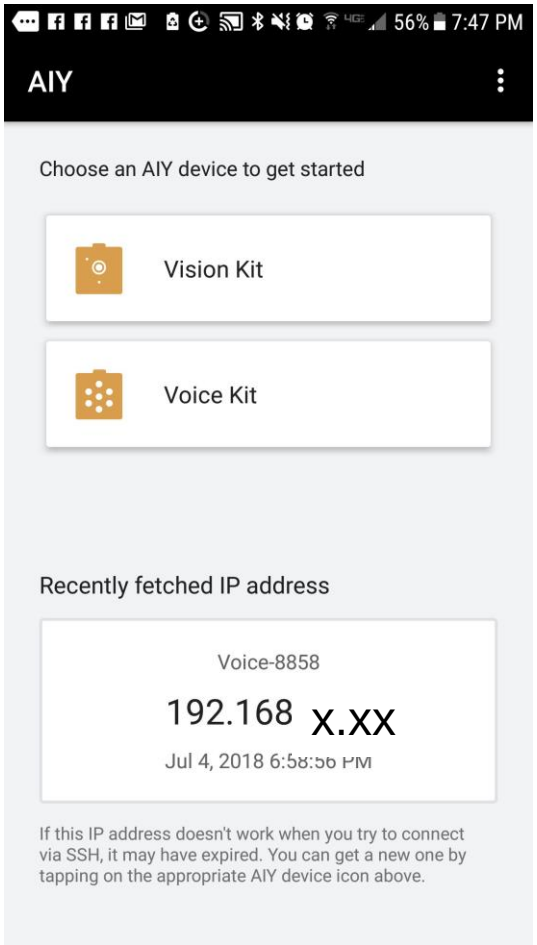
Vision Kit Assembly





Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow



Connect to Your Kit: Option 1

(p. 38/74)

Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

USE THE JOY DETECTOR

Try out Joy Detector

p.36/74

75. Try out the Joy Detector

Point the Vision Kit toward someone's face (or your own) to try out the Joy Detector Demo.

- Ask them to smile
- Then ask them to smile REALLY BIG
- Then ask them to make a frowny face

The Joy Detector uses machine learning to detect if a person is smiling or frowning, and how much they are doing so. Frowns light the button to blue, and smiles light the button to yellow.

If expressions are *really* big, a sound will play. If the camera sees more than one face, it will evaluate each person's face and sum the joy score of each face.

Source:

https://aiyprojects.withgoogle.com/vision/

Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

```
Linux raspberrypi 4.9.59+ #1047 Sun Oct 29 11:47:10 GMT 2017 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Build info: Thu Feb 22 01:10:07 UTC 2018 @ 3368a38
Last login: Thu Jul 12 00:02:35 2018

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to se
 a new password.

pi@raspberrypi:~ $
```

SSH into the Google AIY Vision Kit
via Putty(pp 40-43/74)

Source:

Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

Stopping the Joy Detector

```
pi@raspberrypi:~ $ sudo systemctl stop joy_detection_demo
pi@raspberrypi:~ $
```

Google AIY Vision Kit (p. 48/74)

Source:

https://aiyprojects.withgoogle.com/vision/

Lab Project: Build a Google Vison Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

(pp. 51-64/74)

Try Image Classification In the Live Camera:

Source:
https://aiyprojects.withgoogle.com/vision/

Lab Project: Build a Google Vison Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

Try Image Classification In the Live Camera:

```
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Build info: Thu Feb 22 01:10:07 UTC 2018 @ 3368a38
Last login: Thu Jul 12 01:50:32 2018 from 192.168.7.24

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
 a new password.

pi@raspberrypi:~ $ ls
AIY-projects-python   bin          Downloads      Music      python_games
AIY-voice-kit-python  Desktop      drivers-raspi  Pictures   Templates
assistant-sdk-python  Documents    models         Public     Videos
pi@raspberrypi:~ $ cd ~/AIY-projects-python/src/examples/vision
pi@raspberrypi:~/AIY-projects-python/src/examples/vision $ ls
annotator.py              faces.jpg                        leds_example.py
buzzer                    gpiozero                         object_detection.py
dish_classifier.py        image_classification_camera.py   object_meter
face_camera_trigger.py    image_classification.py          __pycache__
face_detection_camera.py  image.jpg
face_detection.py         joy
pi@raspberrypi:~/AIY-projects-python/src/examples/vision $ ./image_classificatio
n_camera.py
```

Source:
https://aiyprojects.withgoogle.com/vision/

Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

Image Classification running:

Detecting a laptop screen

```
lampshade/lamp shade=0.32        |       spotlight/spot=0.09     |       monitor=0.05     |
lampshade/lamp shade=0.39        |       spotlight/spot=0.23     |       candle/taper/wax light=0.06     |
lampshade/lamp shade=0.57        |       candle/taper/wax light=0.10     |       spotlight/spot=0.09     |
lampshade/lamp shade=0.45        |       table lamp=0.18 |       candle/taper/wax light=0.14     |
lampshade/lamp shade=0.37        |       monitor=0.09    |       screen/CRT screen=0.09  |
lampshade/lamp shade=0.38        |       table lamp=0.21 |       desktop computer=0.07   |
lampshade/lamp shade=0.15        |       projector=0.10  |       screen/CRT screen=0.09  |
lampshade/lamp shade=0.10        |       table lamp=0.10 |       screen/CRT screen=0.08  |
spotlight/spot=0.02      |       shower curtain=0.05     |       matchstick=0.04 |
```

Lab Project: Build a Google Vision Kit: The Intelligent Camera. . .

Intelligent Camera Build Workflow

Additional Demos to explore with the Vision Kit:

- ./face_detection_camera.py
- ./face_camera_trigger.py
- raspistill –w 1640 –h 922 –o image.jpg
- ./object_detection.py –input image.jpg

Question 5 :

What linux commands allows you to check and change file directories?