CEC Continuing Education Center

DesignNews

Getting Hands-On With Automated Inspection Concepts Using AI-Based Smart Cameras

An Introduction to Automated Inspection Concepts

Sponsored by

DigiKey

informa markets

Webinar Logistics

- Turn on your system sound to hear the streaming presentation.
- If you have technical problems, click “Help” or submit a question asking for assistance.
- Participate in ‘Attendee Chat’ by maximizing the chat widget in your dock.

Dr. Don Wilcher

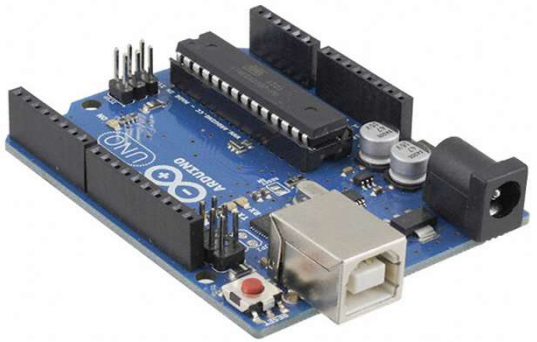
Visit ‘Lecturer Profile’ in your console for more details.

Course Kit and Materials

Pixy2 CMUCAM5

Pan/Tilt2 Servo Motor Kit for Pixy2

Arduino Uno Rev 3



M5Stack AI Camera

M5GO IoT Starter Kit V2.7

Agenda:

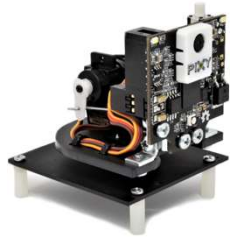
- Inspection Techniques Explained
  - a) Overview
  - b) Approaches
  - b) Devices
  - c) Integrated Systems
- Automated Inspection Systems Explained
  - a) Overview
  - b) Approaches
- Teachable Machine
  - a) Overview
  - b) Transfer Learning (TL)
- Lab: Introduction to Teachable Machine

Seminal Research Perspective

"Inspections are performed in virtually every production system. Their purpose is to verify that the production operations were carried out properly and that the production output meets the expectations of the customer" (Ben-Gal et al., 2002).

Inspection Techniques Explained: Overview

- Inspection is how poor quality is detected and good quality is assured in products produced in a production process.
- Inspection is carried out manually using various technologies that examine specific variables.
  a) quality characteristics of the product)
  b) product attributes (to set standards).
- Various technologies used in inspection activities include:
  a) sensors
  b) instruments
  c) gauges



Inspection Techniques Explained. . .
Approaches

- Some inspection techniques use manually operated devices such as:
  a) micrometers
  b) calipers
  c) protractors
  d) go/no-go gauges
- Today's inspection techniques are based upon modern technologies such as:
  a) Coordinate Measuring Machines (CMM)
  b) machine vision.

Note: This webinar will focus on Artificial Intelligence (AI) and Machine Learning (ML) techniques for Automated Inspection Concepts.

Question 1

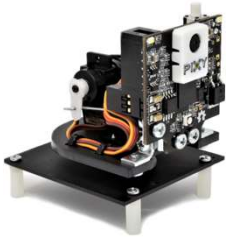
Some inspection techniques use manually operated devices such as

a) micrometers, scales, protractors, go/no-go gauges.

b) micrometers, rulers, protractors, go/no-go gauges.

c) micrometers, voltmeters, protractors, go/no-go gauges.

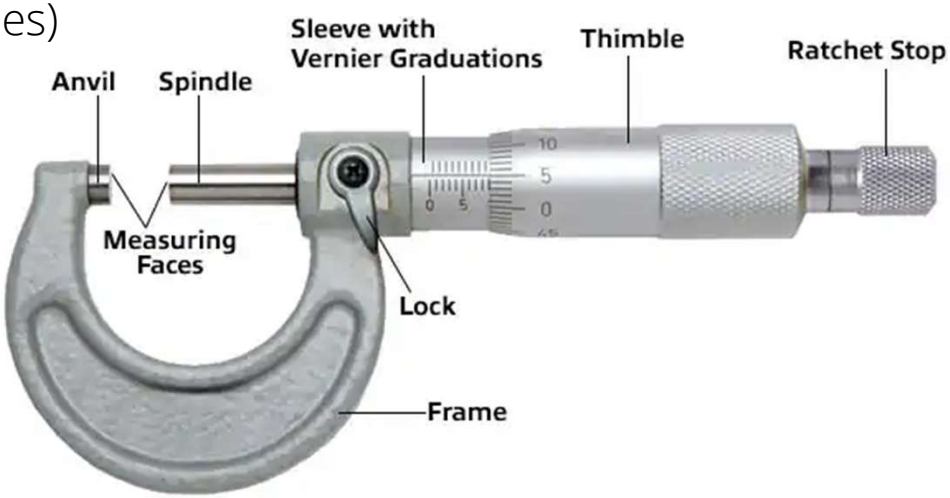
d) micrometers, calipers, protractors, go/no-go gauges.



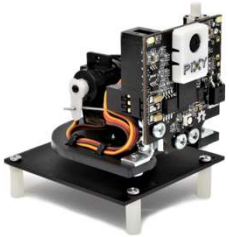
Inspection Techniques Explained: Devices. . .

Micrometers: Digital and Analog

- Used to measure dimensions of small parts
- Used in industry because of their accuracy and resolution
- Can measure parts in 0.001 inches (in) or millimeters(mm)
- Typical Resolution 0.00005 in (50 micro-inches)

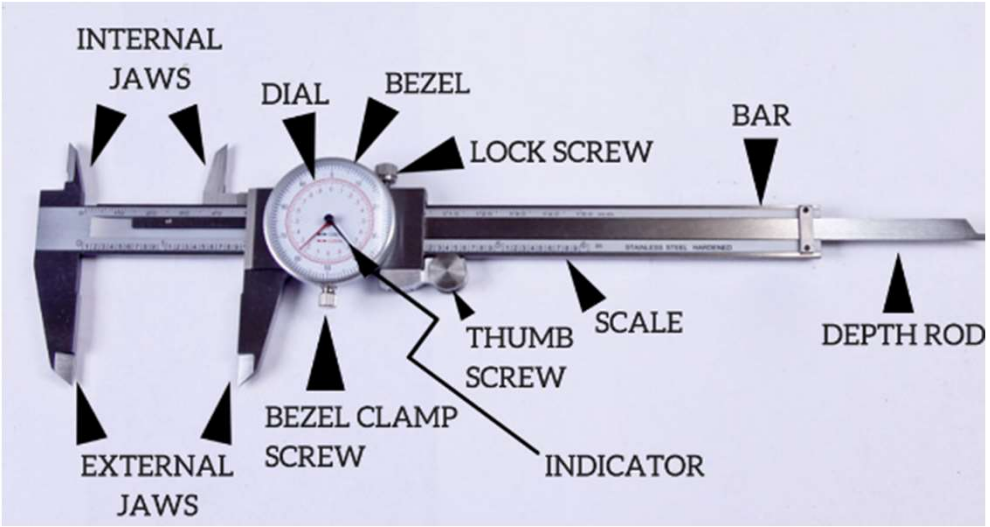


Inspection Techniques Explained: Devices. . .



Calipers: Digital and Analog

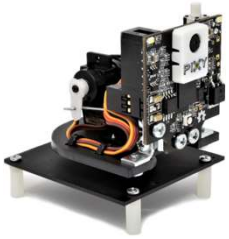
- Used to measure thickness, length, width and diameter of parts.
- Used in industry because of their accuracy and resolution
- Typical Resolution 0.005in (0.01mm)
- Can measure parts in 0.01centimeters (cm)



Inspection Techniques Explained: Machine

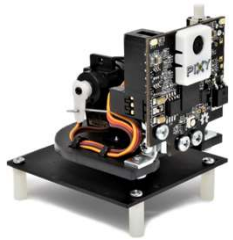
Coordinate Measuring Machine (CMM)

Inspection Techniques Explained. . .



What is Resolution?

The smallest change in value that the instrument can detect or display.



Inspection Techniques Explained: Devices. . .

Go/No-Go Gauges are

- Inspection tools used to check a workpiece.
- Used to check allowable tolerances of a workpiece
- Adjusted to allowable dimension/tolerance

Go/No-Go Gauges operation.

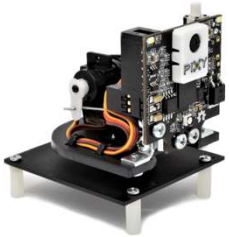
- Adjust gauge to allowable dimension on print
- Place workpiece in the gauges C- Clamp
- If the workpiece is no able to fit in the C-Clamp- No-Go result.
- Workpiece needs to be reworked.

Question 2

What is the name of the element attached to the Anvil and Spindle of a micrometer?

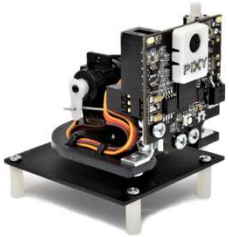
a) metal
b) clamp
c) jaws
d) measuring faces

Inspection Techniques Explained: Integrated Inspection Systems. . .



- An Integrated Inspection System (IIS) is a comprehensive approach to quality control and assurance used primarily in
  a) manufacturing environments
  b) production environments
- An IIS combine various technologies and process to ensure:
  a) product meets specified quality standards
  b) production life cycle completeness.

Inspection Techniques Explained: Integrated Inspection Systems. . .



Key Components in an IIS include but not limited to

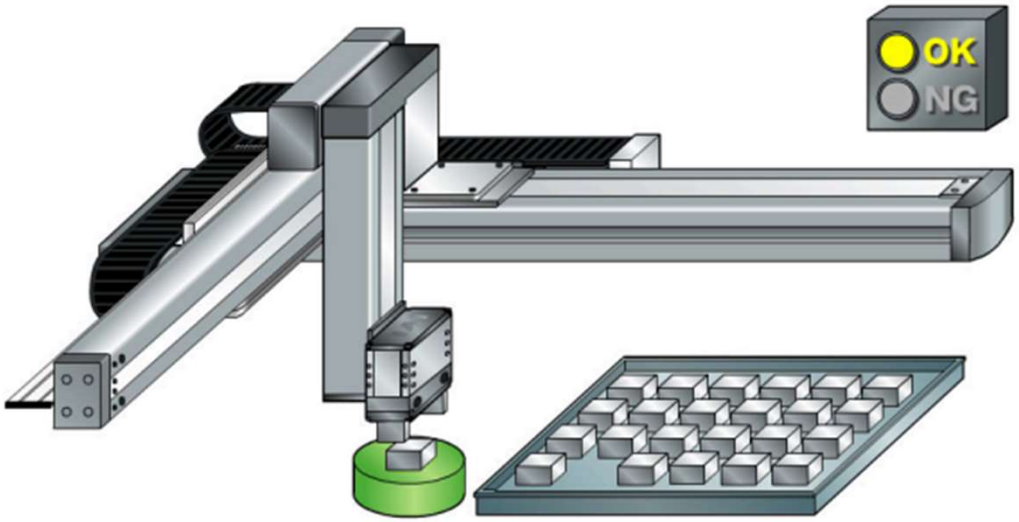
a) Automation
   i. Industrial Controls
   ii. Machinery

b) Multi Technology Integration
   i. Machine Vision
   ii. Laser Testing
   iii. Ultrasonic Testing

c) Real Time Monitoring
   i. Advanced sensors
   ii. Data Acquisition Systems

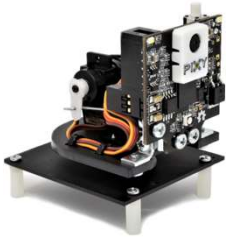
Note: Advanced sensors and Data Acquisition Systems are used for monitoring production processes.

Inspection Techniques Explained: Integrated Systems. . .



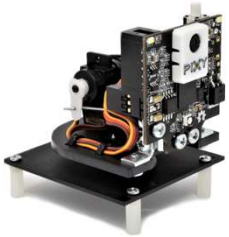
Robotics based Integrated Inspection Systems

Inspection Techniques Explained: Integrated Systems. . .



Robotics based Integrated Inspection Systems

Inspection Techniques Explained. . .
Integrated Inspection Systems



Microscopy

Optical Inspection

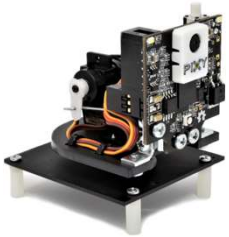
Question 3

An Integrated Inspection System is a comprehensive approach to quality control and assurance used primarily in manufacturing environments and industrial controls.

a) False

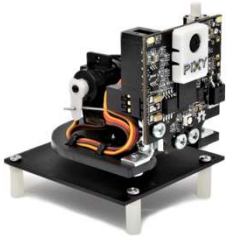
b) True

Automated Inspection Systems Explained: Overview. . .



- Automated Inspection Systems employ advanced technology solutions
  a) evaluate products in manufacturing and production processes
  b) ensure the quality of products in manufacturing and production processes.
- Automated Inspection Systems use no direct human intervention.
  a) quality characteristics of the product) or
  b) product attributes (to set standards).
- Automated Inspection Systems use various technologies to inspect
  a) for defects
  b) measure dimensions
  c) verify assembly processes
  d) ensure compliance with quality standards

Automated Inspection Systems Explained: Approaches . . .



The following key components aid Automated Inspection Systems.

a) sensors and cameras – to capture detailed images or measurements of the product.

b) machine vision technologies – involves the use of cameras and image processing software to analyze visual data.

c) non-destructive testing - allows for inspecting a product's internal and hidden features without causing damage.

d) robotic automation – can perform repetitive and complex inspection tasks with high precision and consistency.

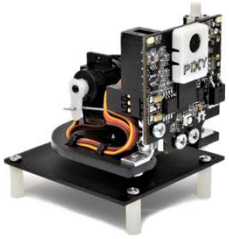
Question 4

Automated Inspection Systems use various technologies to inspect quality products.

a) True

b) False

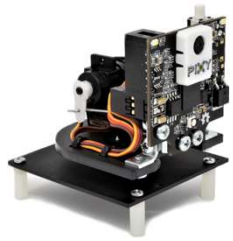
Teachable Machine: Overview



- Teachable Machine is a web-based developed by Google that allows:
  a) users to create machine learning (ML) models.
  b) ML models to be created without writing code (No-Code app).
- Teachable Machine is designed to be user-friendly and accessible to
  a) educators
  b) students (learners)
  c) developers
  d) anyone interested in learning about ML.

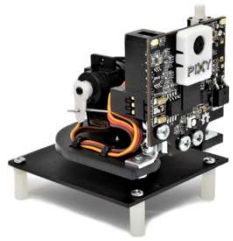
Note: Teachable Machine aims to democratize ML by making an approachable tool that enables a wider audience to experiment with and apply ML creatively and practically.

Teachable Machine: Transfer Learning

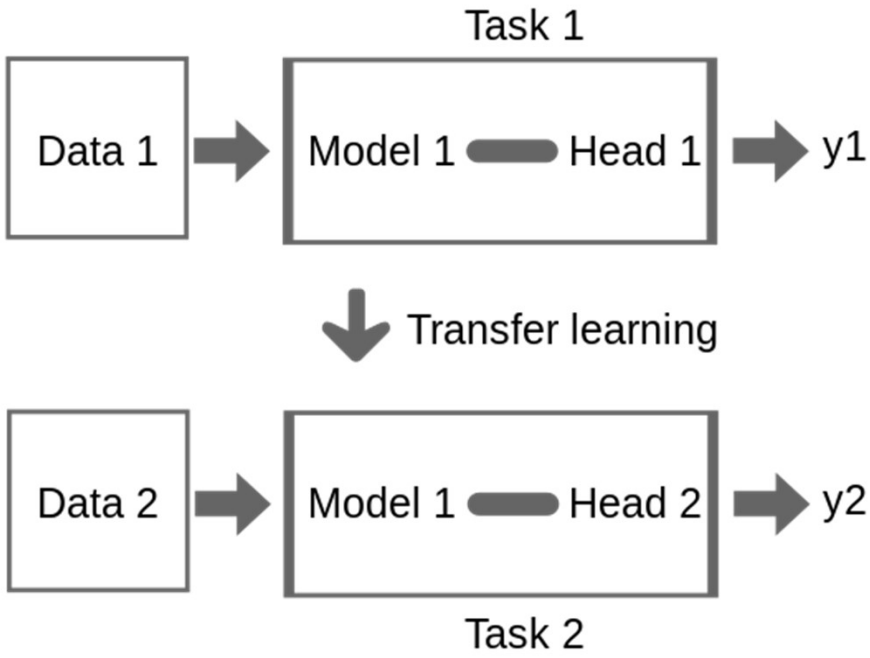


- Teachable Machine employs Transfer Learning (TL) where:
  a) a learning model is developed for the first learning task.
  b) the first learning task is reused for a learning model in a second learning task (Tan et al.2018).
- With a pre-trained model (trained on a large, general dataset), fine-tuning of the model occurs when new specific data is provided.
- TL accelerates the training process and requires fewer data points while maintaining high accuracy.

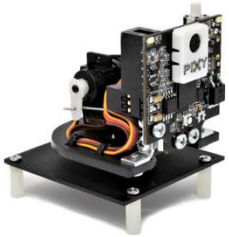
Teachable Machine: Transfer Learning Model

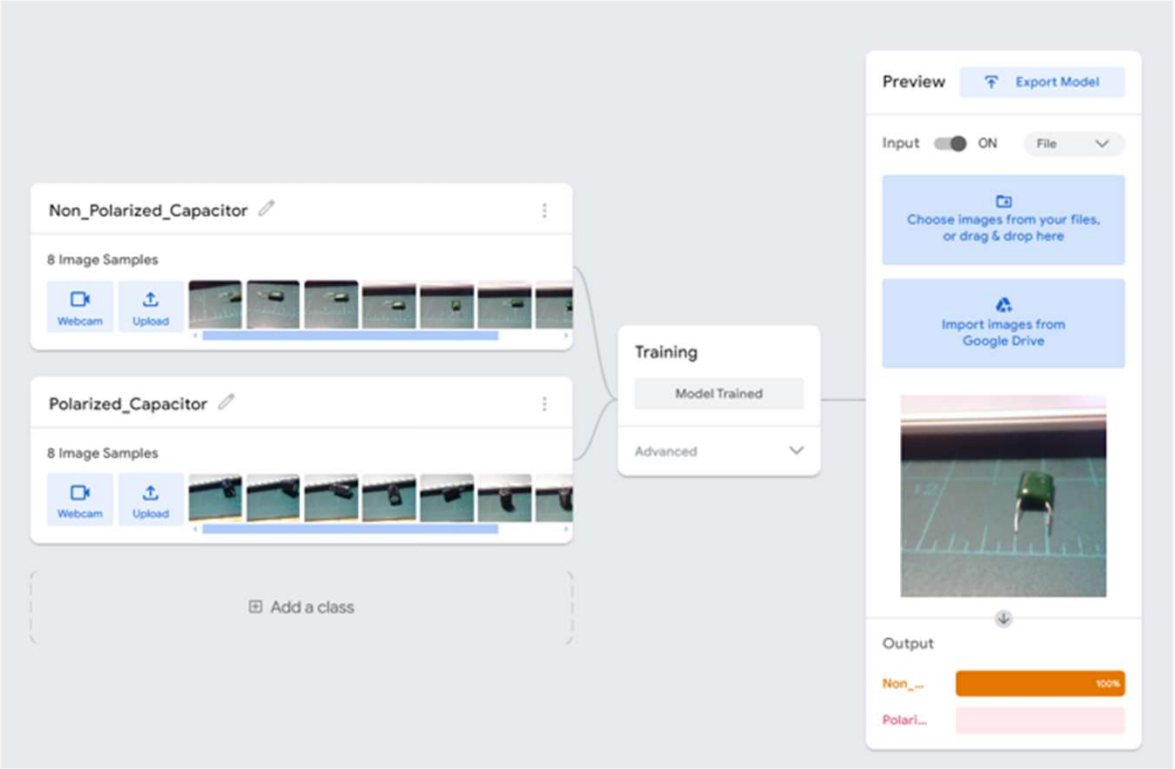


Note:
TL Model mechanism Involves reusing parts of the neural network (such as layers or feature extractors) and fine-tuning them on new data specific to the target task.

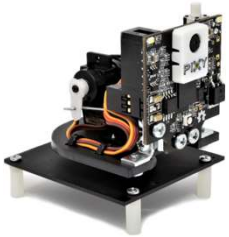


Lab: Introduction to Teachable Machine:





Lab: Introduction to Teachable Machine

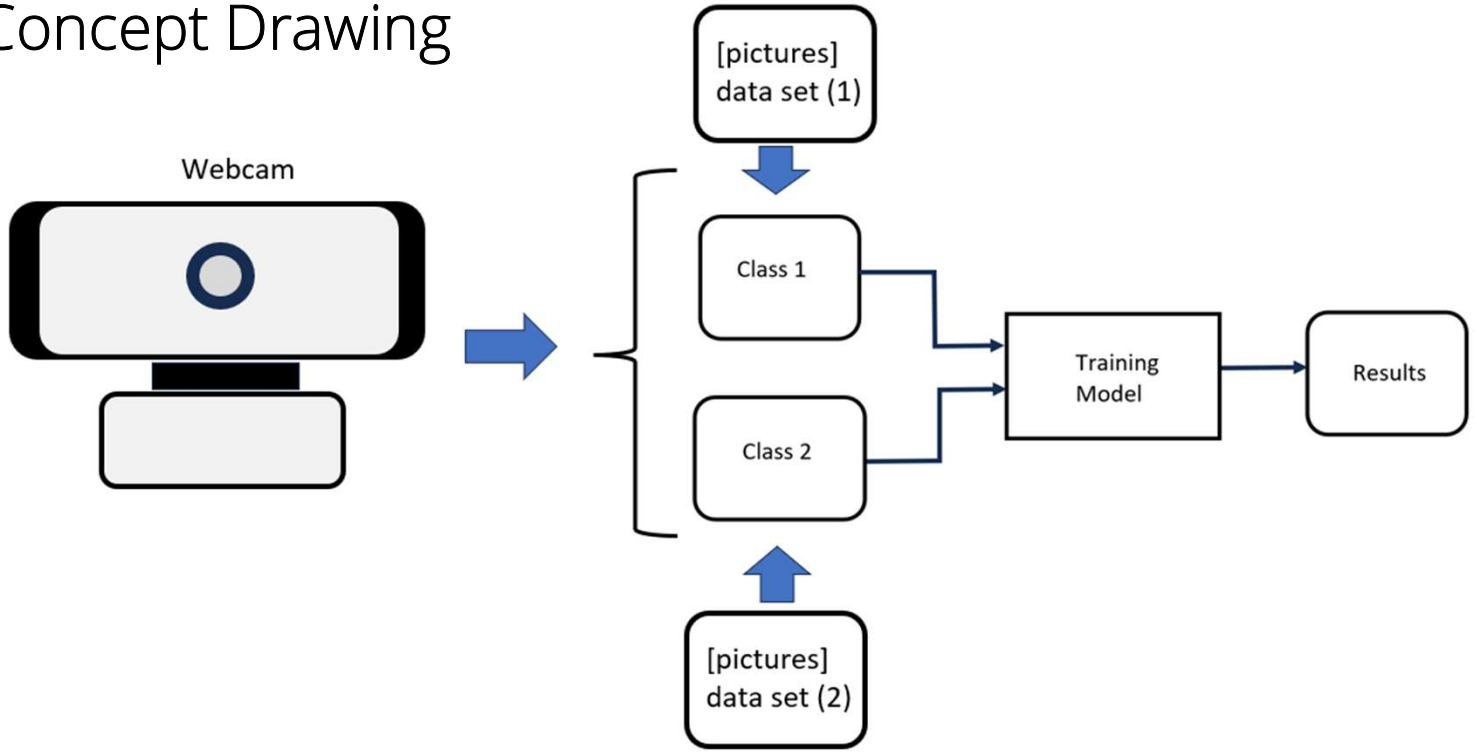


Lab Objectives:

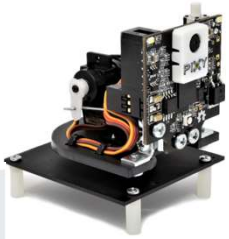
- Participants will learn to capture data (images) using an external and internal webcam.
- Participants will learn to create classes within the Teachable Machine environment.
- Participants will learn to train a model within the Teachable Machine environment.
- Participants will learn to interpret the Teachable Machine results.

Lab: Introduction to Teachable Machine. . .

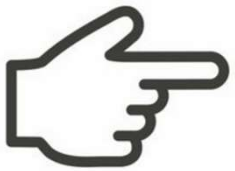
Concept Drawing

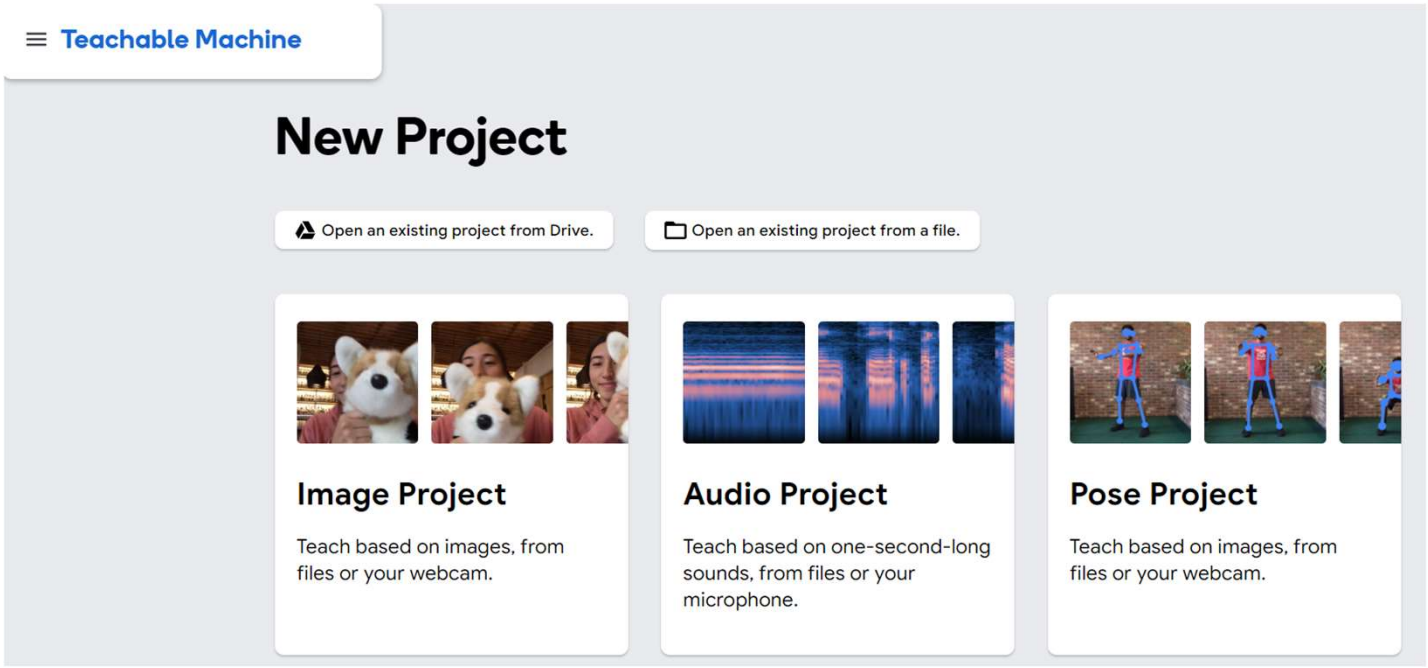


Lab: Introduction to Teachable Machine. . .



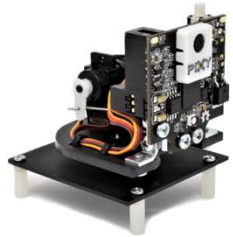
Click On Image Project



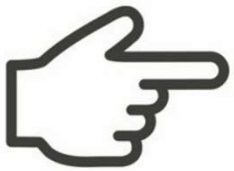


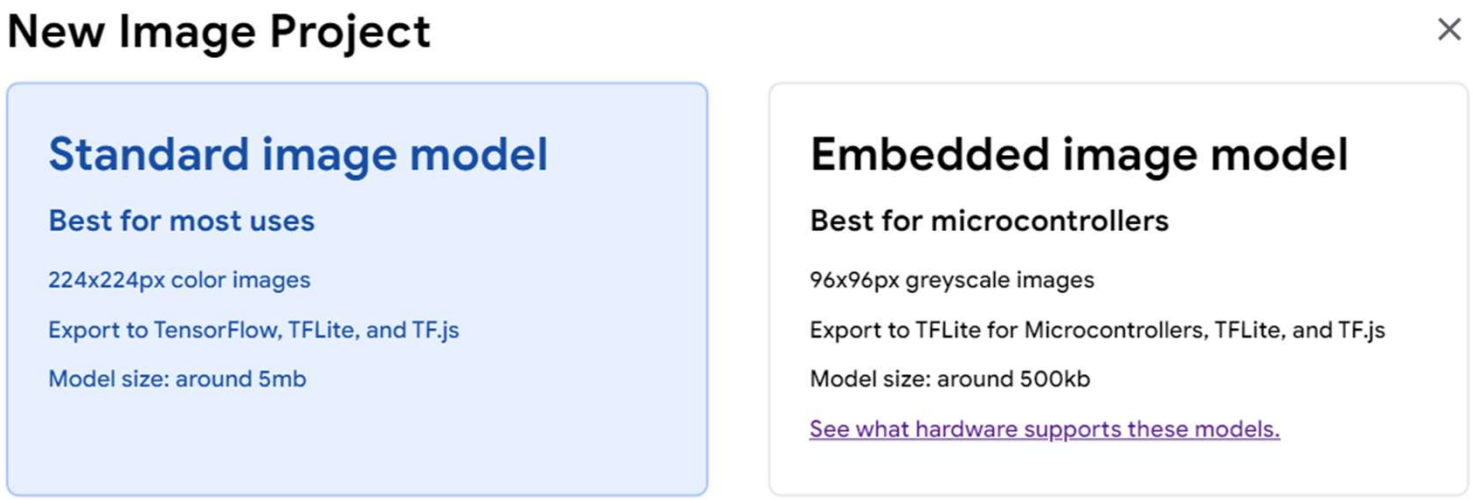
Website URL: https://teachablemachine.withgoogle.com/train

Lab: Introduction to Teachable Machine. . .

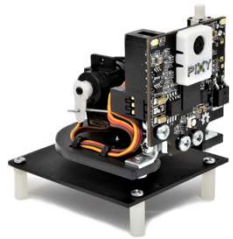


Click On Standard image model

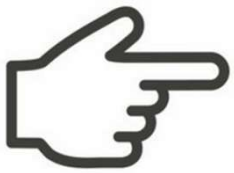


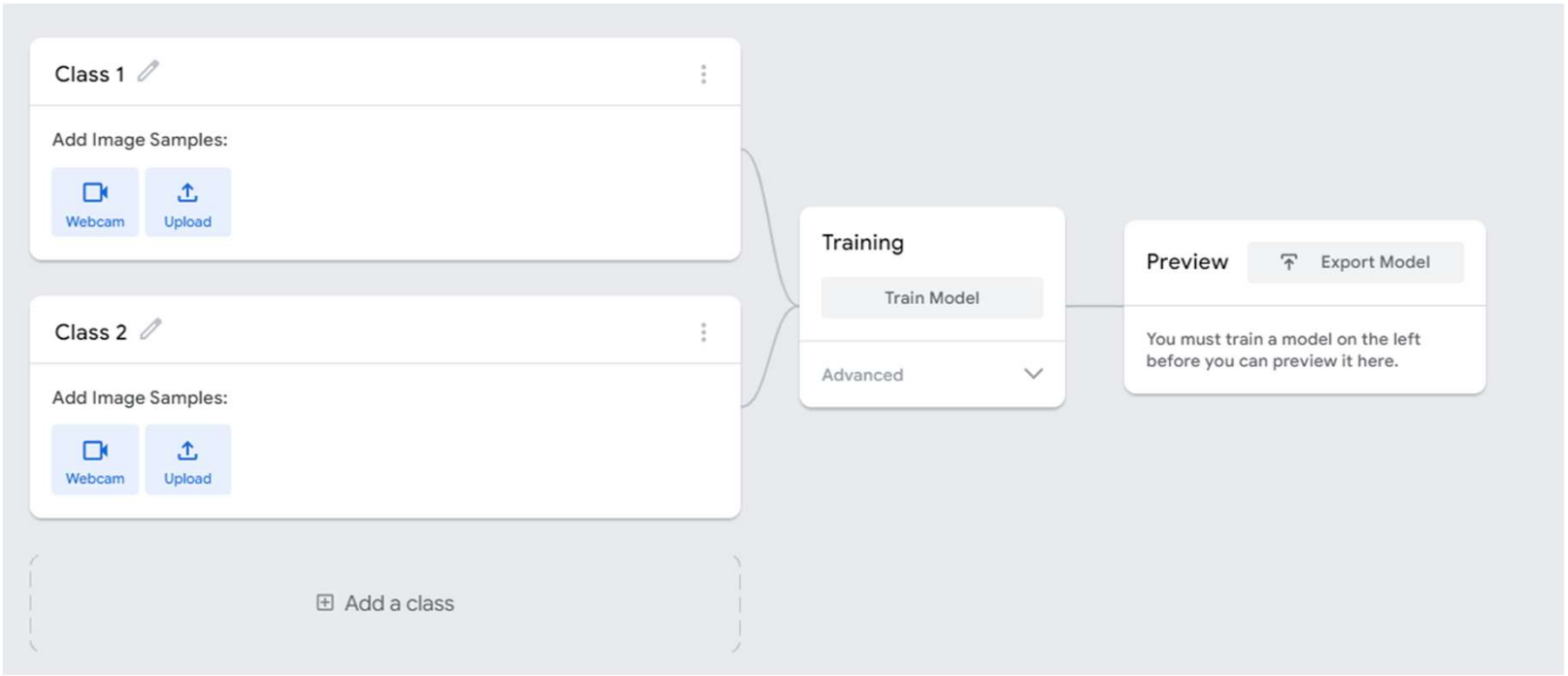


Lab: Introduction to Teachable Machine. . .

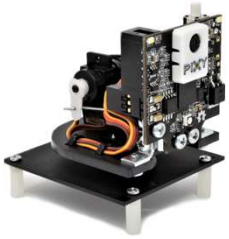


Click Upload Images (pictures)





Lab: Introduction to Teachable Machine. . .



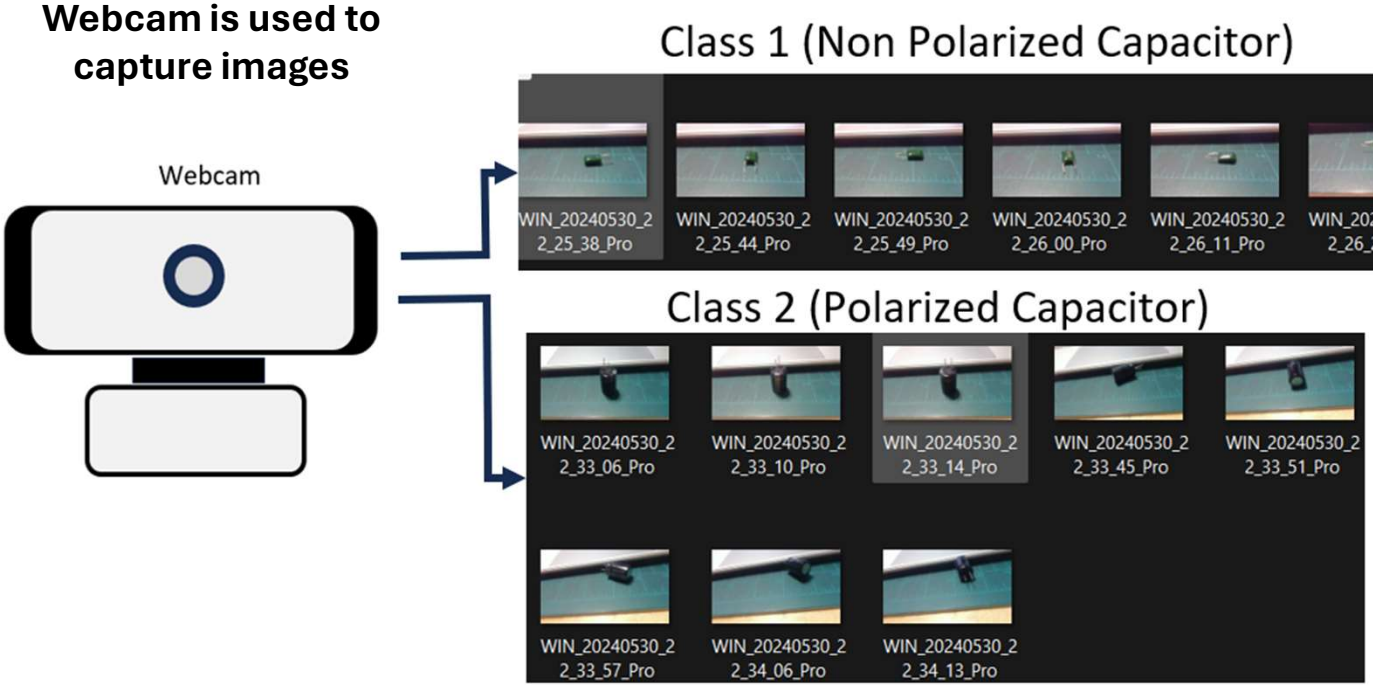
Inquiry Class in ChatGPT

What is a "Class" related to building an Image Classifier model?

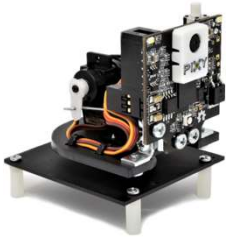
In the context of building an image classifier model, a "class" refers to a category or label that the model is trained to recognize and distinguish among images. For example, if you are building an image classifier to differentiate between different types of animals, each animal type (e.g., "cat," "dog," "horse") would represent a different class.

Lab: Introduction to Teachable Machine. . .

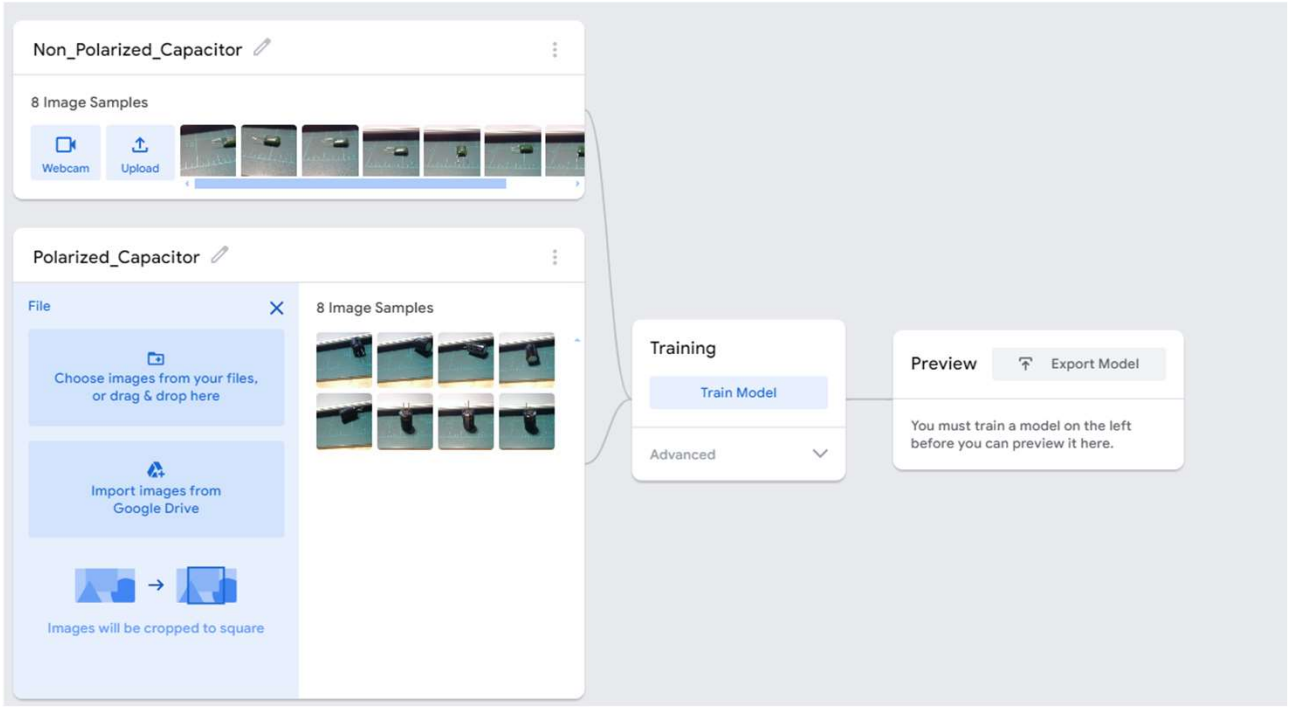
An External/Internal Webcam is used to capture images



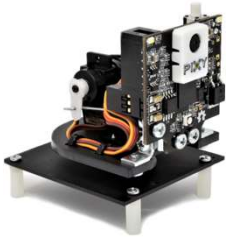
Lab: Introduction to Teachable Machine:



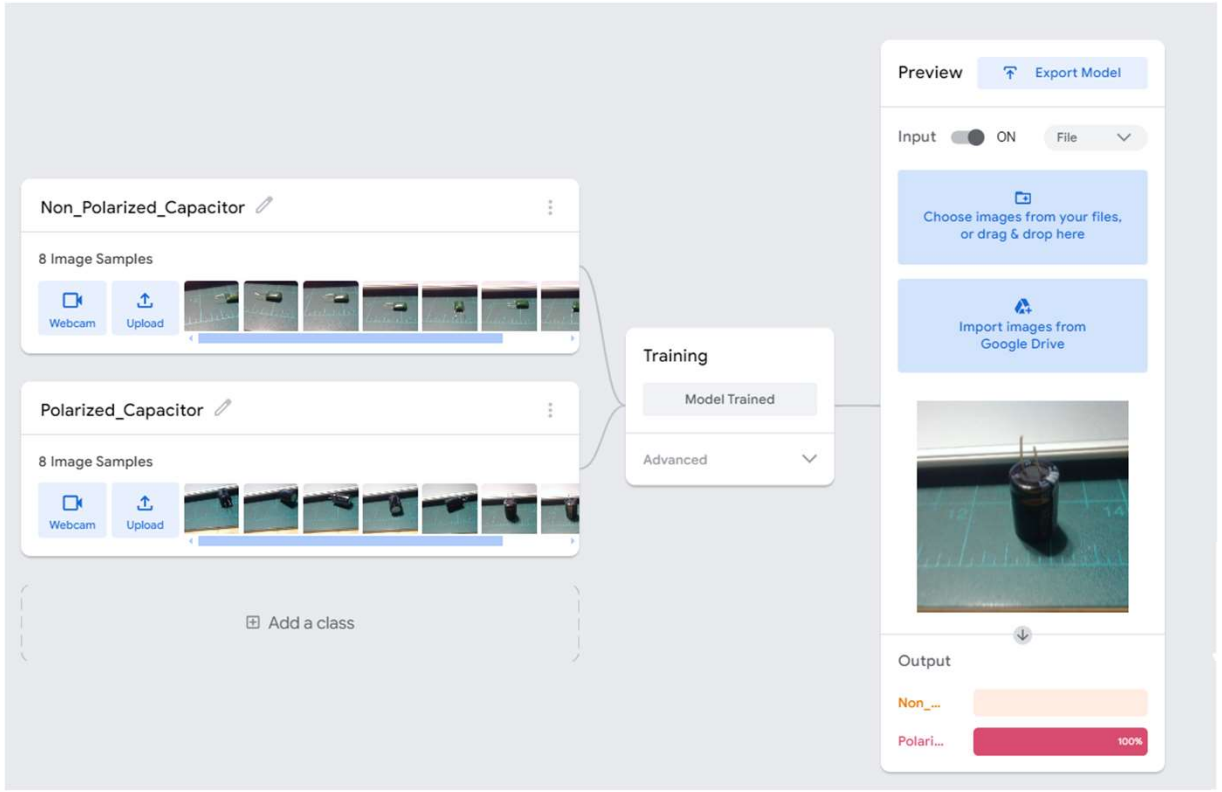
Click the Train Model Button to initiate training



Lab: Introduction to Teachable Machine:

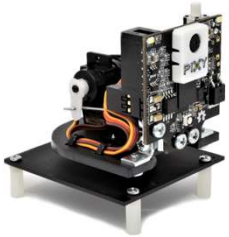


Click the File button to upload an Electrolytic Capacitor image to see the Results

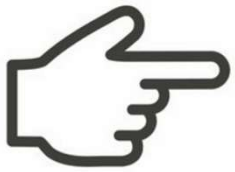


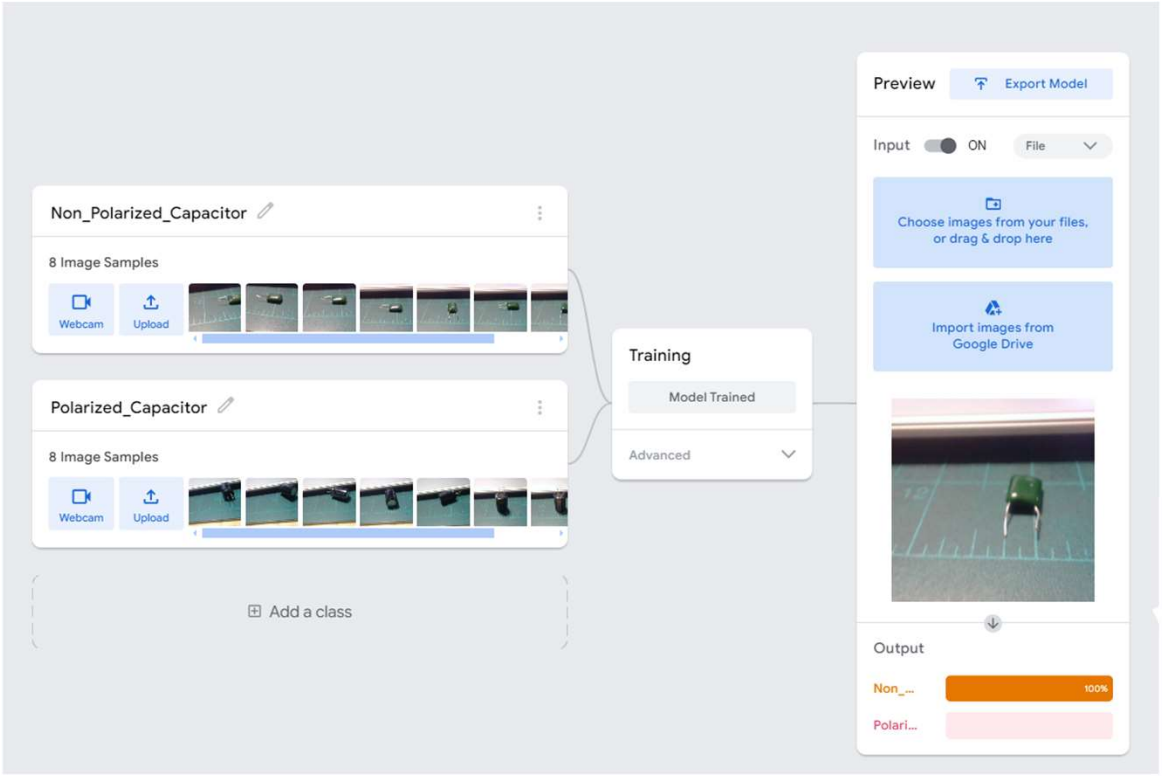
Results

Lab: Introduction to Teachable Machine:



Click the File button to upload a Non-Polarized Capacitor to see the Results





Results

Question 5

According to ChatGPT "Class" is.

a) learning environment.
b) superb characteristics
c) category or label
d) category or function

Thank you for attending

Please consider the resources below:

Ben-Gal, I, Herer, Y. T., & Raz, T. (2002). Self-correcting inspection procedure under errors. *IIE Transactions, 34*, 529 – 540. https://www.academia.edu/12922699/Self-correcting_inspection_procedure_under_inspection_errors

CEC Continuing Education Center

DesignNews

Thank You

Sponsored by

DigiKey

informa markets