Workshop #2

Classification & Color

Appalachian A. I. Corps @ UTK

Notes

Lesson Objective

In this lesson, you will learn about and apply ideas around image classification, neural nets, color, as well as how they can be used to monitor water quality.

Materials Needed:

- A computer with a webcam
- A web browser (Chrome, Firefox, or Safari)

Notes

Workshop Structure

Navigate to:

https://tinyurl.com/aaic-wq-2

Notes

Review

Last workshop we learned:

- Forms of Nitrogen in Water
  - Nitrate
  - Nitrite
- EPA Limits?

Notes

Review

Last workshop we learned:

- Roles of Nitrogen in Water:
  - Nutrient
  - Pollutant
    - Waste runoff
    - Acid rain
    - Fertilizer

Notes

Review

Last workshop we learned:

- Using Python to store, summarize, and visualize data
  - Store data in a list
  - Useful functions:
    - `len()`
    - `min()`
    - `max()`

Notes

Review

Last workshop we learned:

- Using Statistics to Summarize Data
  - Measures of Center
    - Mean
    - Median
  - Measures of Spread
    - Range

Notes

Section 1

Meet the Buoy!

Notes

Meet the Buoy!

Later this semester, we will be deploying these Smokey Buoys!

Notes

Buoy In Action!

Notes

The Buoy: Test Strips

- Smokey Buoy also uses test strips to monitor nitrate concentrations in water
  - Like we did in the first workshop!
  - The buoy's strips are just made a bit differently...

Notes

The Buoy: Test Strips

Start with the same test strips

Notes

The Buoy: Test Strips

Remove the pads and adhere onto a long strip of material

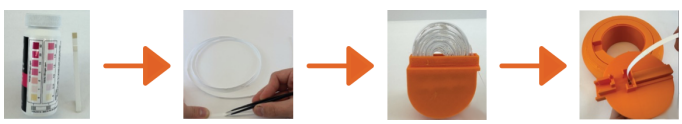
Notes

The Buoy: Test Strips

Roll up strip inside canister

Notes

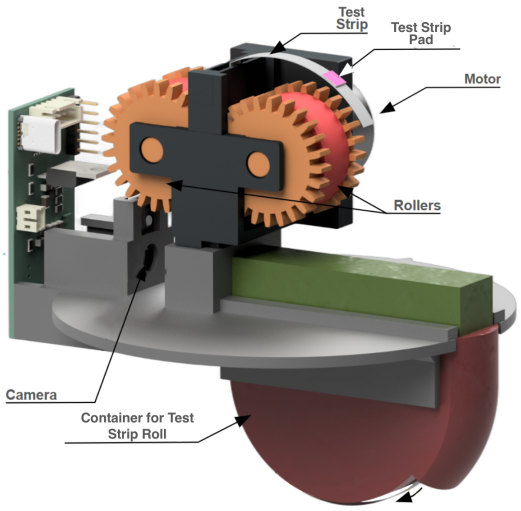
The Buoy: Test Strips



Strip dispenses out of the canister to be fed through the roller

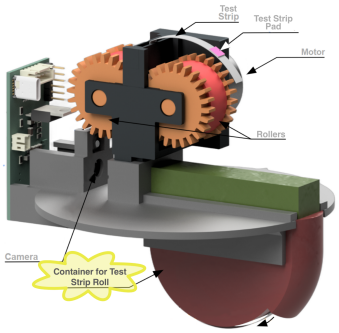
Notes

The Buoy: Other Parts!



Notes

The Buoy: Container for Test Strip Roll

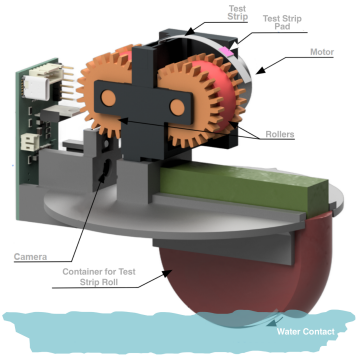


Container for Test Strip Roll

The canister stores the rolled-up test strip and feeds it out as the motor and rollers advances it.

Notes

The Buoy: Water Contact

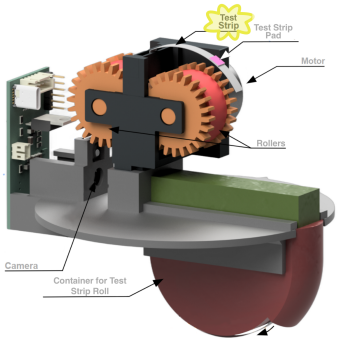


Water Contact

There is an opening in a chamber of the canister, allowing the strip to contact the water.

Notes

The Buoy: Test Strip

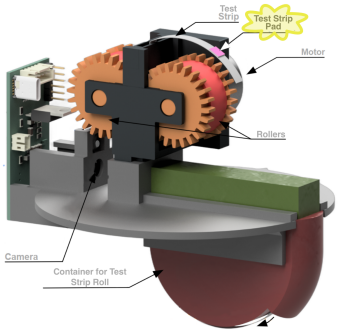


Test Strip

The test strip feeds up from the canister and through the rollers.

Notes

The Buoy: Test Strip Pad

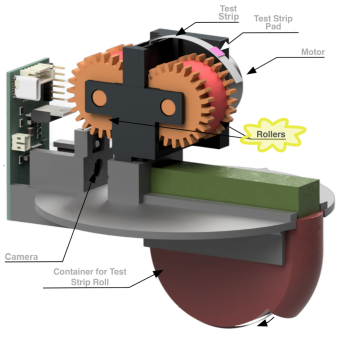


Test Strip Pad

The reactive pad on the strip changes color when exposed to nitrates in water.

Notes

The Buoy: Rollers

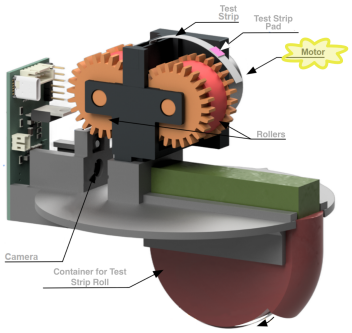


Rollers

The rollers grip the test strip and advance it.

Notes

The Buoy: Motor

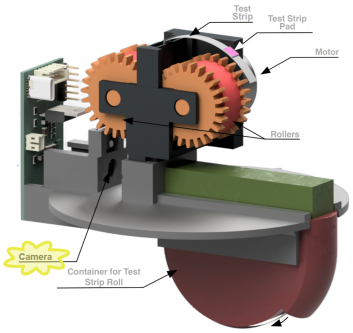


Motor

The motor drives the rollers, which grip and advance the test strip.

Notes

The Buoy: Camera



Camera

The camera acts like the "eyes" of the buoy. It watches for a pad to come into frame and, when it does, also takes a photo.

Notes

Discuss: In Your Group

Thinking back to the nitrates activity from last week...
- What are the **benefits** to using a computerized buoy to conduct water quality tests?
- What are the **drawbacks**?

Notes

Section 2

Intro to Classification

Notes

Intro to Classification

Checkpoint 2. a: Which banana(s) would you eat?

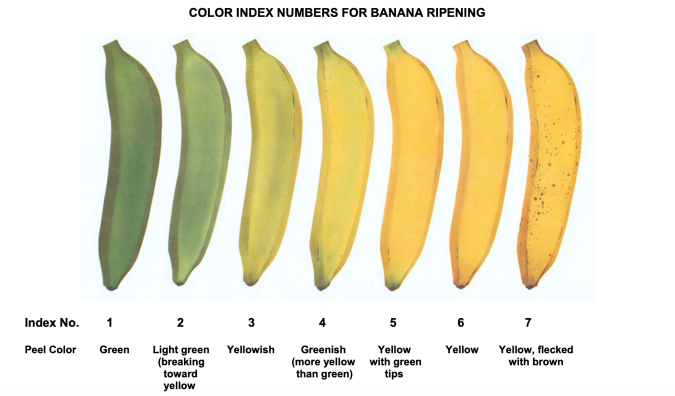


Figure 1: Source: US Department of Agriculture

Notes

Intro to Classification

- People make decisions about ripeness daily: grocery shoppers & farmers alike.
- These decisions—judging if a fruit/vegetable is ripe—are called **classification**.
- Classification = sorting items into groups based on appearance or behavior.

Notes

Use of Classification in Agriculture

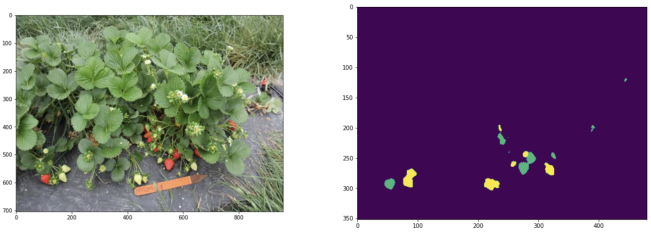
- AI can help make classification decisions, saving time and labor for farmers
- Example: At University of Maryland, AI is used to identify ripe crops in fields

Figure 2: Source: Liu, T., Chopra, N., & Samtani, J. (2022). Information system

Notes

Use of Classification in Agriculture

Checkpoint 2. b: Review the figure below. In image (b), what do you think the yellow represents? The green?



(a) (b)

Notes

Binary Classification

Two possible Outcomes:

Not Ripe
Ripe

Notes

Types of Classification

Classification of Strawberries

- **Binary Classification**: Two possible outcomes (e.g., Ripe vs. Not Ripe)
- **Multiclass Classification**: More than two possible outcomes (e.g., Underripe, Ripe, Overripe)

Notes

Multiclass Classification

More than Two Outcomes:

Underripe
Ripe
Molded

Notes

Multiclass Classification Example [1]

Notes

[1] Drake, A. (2025, April 26). AI for agriculture: How Georgians use robots on the farm [Video]. WRDW. https://www.wrdw.com/2025/04/26/ai-agriculture-how-georgians-use-robots-farm/

Pros of Using AI for Classification

- Using AI has **advantages** and disadvantages

Pros:

- Handles millions of items quickly
- Makes classification decisions quickly
- Spots tiny differences humans miss

Notes

Cons of Using AI for Classification

Cons:

- Needs tons of examples to train the computer
- Bad examples = bad decisions (e.g., train only on sunny photos, it fails on cloudy days).

Notes

Discuss: In Your Group

Checkpoint 2. c: If farmers use a certain company to train and decide when to pluck or harvest fruits/veggies, who gets to own that data? Why?

Notes

Discuss: In Your Group

Checkpoint 2. d: Let's say the company becomes better at identifying ripe fruits because they used data from your farm. Now, they want to up their subscription fees for farmers (including you) to use their model. Is that fair? Do you have any suggestions or solutions?

Notes

Section 3

Classification: Your Turn!

Notes

Classification Activity - Train

- Fruit Assortment
  - Apples, Orange, Ball
- Device
- Lab sheet

Notes

Teachable Machine

Teachable Machine

- Uses Python in the background
- Helps users build classification models

Notes

Let's Go

Go to Teachable Machine at:

tinyurl.com/google-tm

*** We'll walk through this together!

Notes

Section 4

Evaluate Your Model!

Notes

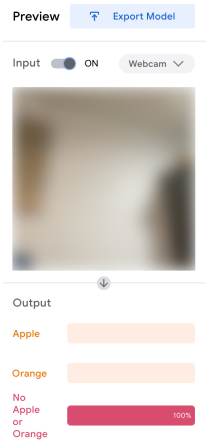
Evaluate Your Classifier

- Some models can be very accurate, while others might struggle
- Let's put your model to the test!

Notes

Evaluate Your Classifier

Use the "Preview" pane on the right side of the Teachable Machine screen



Now test your model!

- Hold up each of your objects on your handout to the camera
- Record the results
- Does your model correctly classify each object?
- With what confidence?

Notes

Discuss: In Your Group

- How did your model perform?
- Were any objects classified incorrectly?
- Were any objects classified with low confidence ($< 80\%$)?

Notes

Classification in Smokey Buoy

Notes

Section 5

Neural Networks

Notes

How Does Your Model Work?

- Under the hood of a classification model is a **Convolutional Neural Net (CNN)**
- CNNs are trained to recognize patterns in images

Notes

How Does Your Model Work?

Prioritize understanding big picture over math

Notes

How Does Your Model Work?

Notes

Discuss: How Does Your Model Work?

Checkpoint 5. a Contrast how each layer type works in a neural net:
- the input layer
- the hidden layers, and
- the output layer

What might each layer do if your model is trying to classify whether or not an image is a cow?

Notes

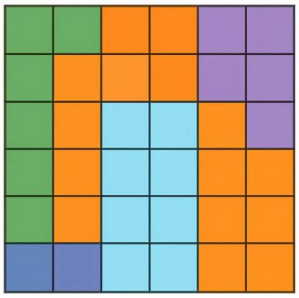
Section 6

Computers & Color

Notes

Understanding RGB

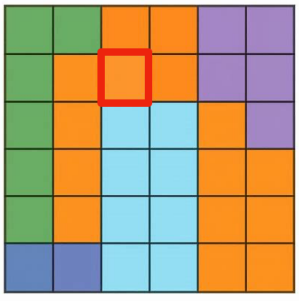
An image is a combination of millions of little squares called **pixels**



Notes

Understanding RGB

Each pixel has a **color**



Notes

Understanding RGB

Each color is a combination of three values:

- **R**ed = 252
- **G**reen = 148
- **B**lue = 43

Notes

Section 7

Computers & Color Activity (Pt. 1)

Notes

Color –> RGB Values

Checkpoint 6. a: Exploring color and RGB Values

Materials Needed:

- APPLET
- Fruit from previous activity
- Handout

Notes

Color –> RGB Values

- Use the applet and follow the instructions on the handout.
- We will do the first together!

Notes

Colors –> RGB Values

- We learned every pixel has a value for Red (R), Green (G), and Blue (B)
- Each value can range from 0 to 255

Notes

Section 8

Computers & Color Activity (Pt. 2)

Notes

RGB Values –> Color

Checkpoint 7. a: Using RGB Values to Create Color

Materials Needed:

- Slider Tool on Pg. 7
- Handout

Notes

Using RGB Values to Create Color

- Use the slider tool below to convert the RGB values to colors
- Record your answers on the handout
- We'll do one together!

Notes

Using RGB Values to Create Color

Checkpoint 7. b: Use the slider tool!
What color does this RGB value represent? (110, 164, 212)
Just like the computer, predict what fruit this could be from!

Notes

Section 9

Exit Ticket

Notes

Exit Ticket

Great job! You've learned so much!

Share what you've learned on the **Exit Ticket**.

Notes

Section 10

Exercises

Notes

Exercises

Want to practice what we've learned?

Try the **Exercises**.

(Ask Your Teacher For the Link.)

Notes

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