Review:

Image Sensor: similar to the retina on the back of a human eye, measured in millimeters, and is about the size of a fingernail, made up of individual color sensors (called pixels)
Sensor Resolution: defined by the number of pixels on the Image Sensor
Focal Length: how far the image sensor is from the lens of the camera
Lens: where the light passes through to get to the image sensor, imagine this as a simple pinhole that is centered in front of the image sensor
Image Plane: an imagined image in front of the pinhole that is the same focal length distance as from the pinhole to the image sensor (this allows us to use an upright image, rather than an upside down image)
Stereo Vision: allows the robot to calculate the distance to nearby objects by using 2 cameras that are parallel to each other and the cameras are a known distance apart
Steps:

1. Take a picture – This step produces an image (a 2-dimensional representation of the real-world)
2. Process the Image – find interesting points such as corners and edges of objects in the image – we'll call these interesting points, features
3. Calculate information – Use the features to extract information about the scene in the image such as where objects are, or distance to particular features or which objects are in view.

Line through two points:

$$z - z_c = \frac{f - z_c}{A_x - x_c}(x - x_c)$$

- x_c , z_c is the center of the camera – typically one camera will be set at the origin and is 0,0, the other will typically have the x position as the offset between the two cameras.
- A_x is the position in mm of the pixel of the feature in the image – find by multiplying the number of pixels from center by the ratio of sensor size to pixel count (i.e. if the sensor is 2000 px wide and 10 mm wide than the ratio would be 200 px per mm).
- For the both cameras, if the pixel of the feature in the image is to the left of center, than the value will be negative.
- You will have two equations with z and x in them. Solve by substitution, or by systems of equations.

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Challenge Questions:

With cameras in robots collecting all of the visual information that they see, what are physical and digital security measures that can be taken to help secure the visual data from cameras?
How do these security measures do that?

Physical:
These items will secure access ports (USB ports, ect) that connect to the computer's memory location(s)

- Keypad (pin / passcode)
- Key lock
- Fingerprint
- Retinal scan

Digital:
This item scrambles the data so that it is unreadable to anyone who steals it

- Encrypt data (have a digital security key to decrypt)

These items stop the ability to connect to the internet, where the data is more accessible by criminals

- Turn off access by the click of a button on the robot's software program
- Turn off access by removing a network component that allows the robot to connect to the internet (also Physical)

From your list of security measures above, which would you recommend based on the criteria of: efficiency, feasibility, and ethical impacts?

Security Measures:

- Keypad (pin / passcode) / Key lock
  - Efficient, Feasible (if weight isn't critical), and minimal ethical impacts (person with no fingers couldn't access using this method)
- Fingerprint / Retinal scan
  - Efficient, Higher cost and weight (for drones) makes this less feasible, Ethical concern: uses employee biodata to secure robot data - which is more valuable? If biodata is more valuable, then should it be used to protect less valuable visual data from the robot's camera?
- Encrypt data
  - Efficient, Feasible (many encryption algorithms available), and no ethical impacts
- Turn off access by the click of a button on the robot's software program
  - Efficient (to program and User just clicks of a button), not feasible if robot uses other data from internet to function, and no ethical impacts
- Turn off access by removing a network component that allows the robot to connect to the internet (also Physical)
  - Efficient (to program and User just clicks of a button), not feasible if robot uses other data from internet to function and User must be at robot's location to engage security feature, and no ethical impacts

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