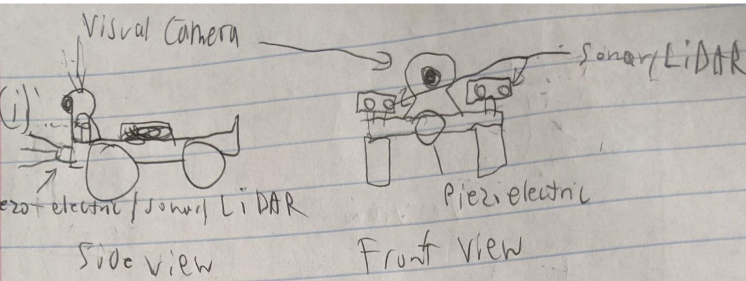
1. Problem Definition
    a. Clearly define what you believe is a difficult challenge that you'll be considering for this assignment. Why is it important to address this problem?
        i. I believe a difficult challenge of the assignment would be designing a visual system for the OTV. This is important because most, if not all, of the tasks expected of the OTV require visual cameras.
    b. Write down everything you know about the specific issue you are targeting. Use the Project Details documents to help you find this information.
        i. OTV is expected to react based on visual feedback (colors, shapes, etc)
        ii. OTV is expected to navigate in areas that may only be suited for visual feedback
        iii. The site is randomized, making sensor-less automation implausible
        iv. OTV is expected to be able to transmit data on the crash site's abnormality face
        v. OTV must be able to align and connect to a port precisely (camera must be high res)
        vi. OTV must be able to identify wood debris and active flames
        vii. OTV must be able to correctly tell apart plastic material vs copper material
    c. Conduct a little bit of research online to give yourself some more background knowledge about the issue you've chosen to target. Write down valuable findings that could inform your design exploration and decision-making processes.
        i. Cameras must be able to distinguish between objects and the background, and the distance from the object to the vehicle
        ii. Image recognition algorithms are used to identify what is an object and what isn't
        iii. Using geometry and camera specifications it is possible to identify distance solely from the camera
        iv. The deep learning algorithm usually works by receiving matrices of numerical values representing a still frame of the camera.
        v. In general, image recognition is able to perform classification, i.e the category of an object, tagging, i.e classification that is able to target several objects, detection, i.e placing a bounding box on an object, and segmentation, i.e bounding an object by the pixels of which it shows up on the image.
    d. Utilizing the same documents as in part 1b, make an explicit list of constraints on your designs.
        i. Camera must be able to differentiate objects at a max distance of 4.5 meters
        ii. Camera must be able to differentiate between multiple different objects
        iii. Camera must be able to differentiate between different colors and shades
        iv. Camera must be able to measure the distance between itself and an object solely by having vision of the object
2. Design exploration
    a. Brainstorm solutions and come up with no less than four different ideas for solving the particular issue you are targeting. Sketch out each solution idea as neatly as possible.

i. The issue of determining distance could be resolved by using multiple other sensor systems such as piezo-electroc, LIDAR, or sonar system alongside visual sensors, and the identification and differentiation of objects could be resolved by using a free image recognition software such as Clarifi, train it to recognize relevant objects, and bounding the object using detection
ii. By using a base measurement of the object's actual size, the object could be identified beforehand using image recognition software, related to a set of object expected sizes, and determining the distance based on that relation, thus only requiring camera usage
iii. By using a push sensor that is of a specified length, the OTV can correctly orient itself to carry out tasks from an object, circumventing the need for measuring distance with a camera or other sensors. A camera will be used to identify the object in question.
iv. By using simple light sensors and piezo-electric, sonar, LiDAR, or push sensors, the OTV could recognize objects solely based off of their color and orient itself based on distance, rather than visual recognition

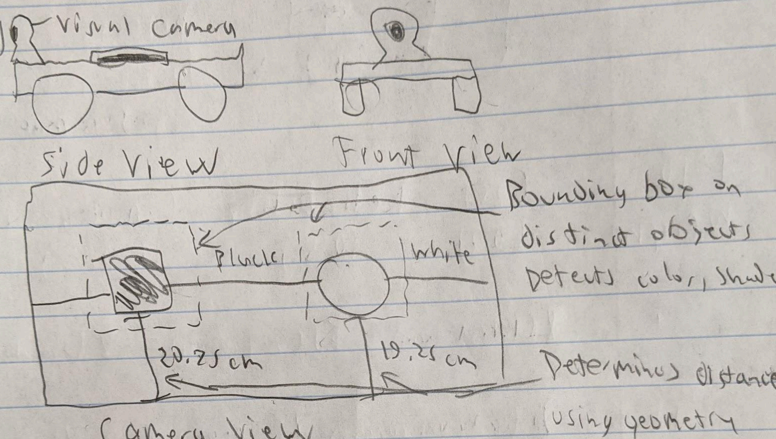
b. Include a short written description next to each design sketch explaining that idea for solving the particular issue.

3. Decision-making
    a. Intuitively, decide which of the ideas you like the best.
        i. Ideas i and ii sound best to me despite being possibly the hardest and most complex to do.
    b. Use a decision matrix to aid in the evaluation of your 4 or more ideas. This requires that you:
        i. generate desired criteria (at least four)
        ii. determine the weights for these criteria
        iii. score the designs using a weighted decision matrix, resulting in a winning idea
        iv. Did the winning idea match your intuition in part (3a)? If yes, write a brief explanation justifying that idea. If no, briefly explain if you would push for your intuitive idea or the idea supported by the decision matrix, or something else, and why.
            1. Yes, my intuition matched that of 3a because using the camera only reduces costs of sensors and is reliable if the camera is of high quality, but the tradeoff is that the detection algorithm for the camera is complex

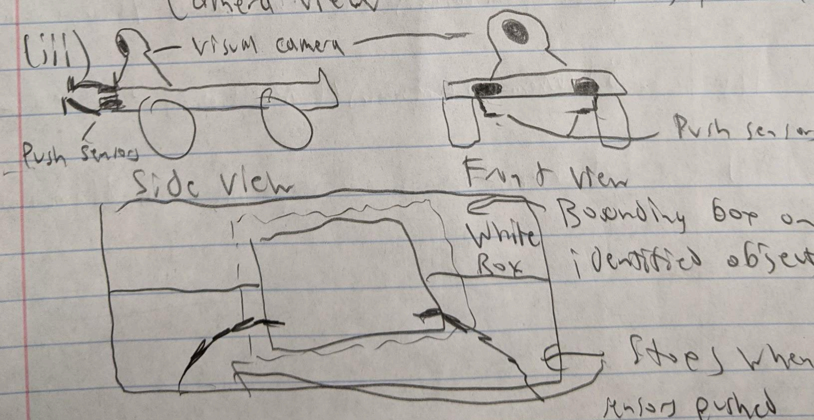
(i)


Visual Camera
Sonar/LiDAR
Piezo+electric/sonar/LiDAR
Piezielectric
Side view
Front view

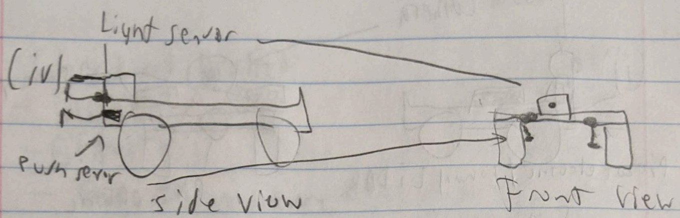
(ii)

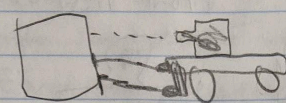

Visual camera
Side View
Front View
Bounding box on distinct objects
Detects color, shade
Black
White
20.25 cm
19.25 cm
Determines distance using geometry
Camera View

(iii)


Visual camera
Push sensors
Push sensors
Side View
Front View
Bounding box on identified objects
White Box
Stops when sensors pushed

(iv)





Detects color of object, bumps into them to stop and determine orientation

1-10 weight	Cost (0.2)	Reliability (0.5)	Complexity (0.5)	Total
i	1 (lots of sensors)	10 (very reliable)	3 (somewhat complex)	6.7
ii	7 (only one camera)	7 (somewhat reliable)	7 (very complex)	8.4
iii	8 (camera and push sensor)	7 (somewhat reliable)	5 (less complex)	7.6
iv	10 (cheapest option)	3 (may be difficult colors)	3 (somewhat complex)	5