3. Object Detection

3.1 NVIDIA Jetson Object Detection

Jetson Nano is a small, powerful computer that lets you run multiple neural networks in parallel for applications like image classification, object detection, segmentation, and speech processing. All in an easy-to-use platform that runs in as little as 5 watts. Just insert a micro SD card with the system image, boot the developer kit, and begin using the same NVIDIA Jetpack SDK used across the entire NVIDIA Jetson family of products. Jetpack is compatible with NVIDIA's world-leading AI platform for training and deploying AI software, reducing complexity and effort for developers. To simply say, it's a small sized computer, taking less power and delivering more.

image from: Pyimagesearch

Figure 1: Nano Jetson

Object detection is the means of locating the presence of objects with a bounding box and types or classes of the located objects in an image.

- Input: An image with one or more objects, such as a photograph.
- Output: One or more bounding boxes (e.g. defined by a point, width, and height), and a class label for each bounding box.

To get to know more about training of model, reading can be done on the following link: How to train an object detector

3.2 Teaser

1. Form of group of 10 students and provide them a Nano Jetson kit.

2. Ask them to start collecting objects around them, which ever they want to be detected. Additionally, they should make a note about what have they collected.
3. Students should bring the objects in front of the Jetson camera and see the output on the screen. This can be done by connecting the Jetson to a computer and executing the following commands on the terminal
   cd jetson-inference
   bash docker/run.sh
   detectnet csi:0.
4. Finally, noting down if their object is detected correctly or not by the Jetson Nano.

After completing the following activity, they should answer the following questions:

1. How was their experience with the Jetson Nano?
2. Which objects did it detect correctly and which it didn't?
3. What were their thoughts about A.I earlier and now?
4. Did they enjoy this activity?

3.3 Brain Storming

- Ready to use Jetson Object detector
- What does AI know
- Limitation and boundaries
- Examples of AI in the present day + references from movies/media
- Insight into capabilities and limitation

One way to arouse the interest in children could be handing over Jetsons to the different groups of children and telling them to make their Jetson detect whatever they like to and ask them to make a note of the things or images that their Jetson could not detect correctly during the whole process so that the limitations of Jetson can be known.

3.4 Ready to use object detection

As the students assemble in groups and are given the NVIDIA Jetson, at first glance it is evident that they would be enthusiastic to see the objects they show on the screen be recognized. They would be provided, or asked to bring, some toys, fruits and other objects to test the working of the Jetson. Using the interface of Snap!, which makes it easier for the students to operate. A block is clicked that captures an image on the stage of Snap! and is recognized by the click of another block. A text-to-speech generator is then activated that narrates the classified object, aloud. This is done several times and a challenge is issued by the teacher to try to trick the Jetson into guessing the wrong object.

3.5 what does AI know? (capabilities)

AI is Artificial Intelligence, which is a branch of computer science. It integrates mathematics, logic, statistics, computer science and other disciplines. In fact, we have been exposed to artificial intelligence very early in our lives, such as mobile phones, sweeping robots, and smart speakers. The extent of which humans have implemented artificial intelligence is incredibly vast, to the point at

which they exceed human capabilities on tasks like speech recognition,complex decision making etc. that may transform human lives drastically. In the case of the NVIDIA Jetson, the only objects that it can identify are the ones in Coco dataset. Here it is only able to identify 90 labels.

3.6 Limitations and boundaries

Since the camera that is used is just a simple webcam that is integrated to the PC. This restricts the students into only a confined region in front of the PC. As the Jetson is connected to the PC, the only available objects that they can allow the Jetson to identify are the ones that that are of reach only at the moment. Since we are using COCO dataset for our object detection, this brings us another limitation. Though COCO dataset, provided by Microsoft, currently leads as some of the best object detection data available. But, COCO only contains 300,000 segmented images with 91 different categories of objects with very precise location labels. Each image contains about 7 objects on average, and items appear at very broad scales. As helpful as this dataset is, object types outside of these 91 select classes will not be recognized. Though, model can be trained on our own to add this to the 91 classes. This requires an effort and lengthy approach but do make the dataset more capable.

3.7 Examples

Once the students have enjoyed playing around with the Jetsons and have had a few objects classified, Assuming that its the first time they have seen objects being classified instantly with their bounding boxes shown, they would be filled with enthusiasm. To this enthusiasm, AI is introduced to them through a YouTube video and an explanation as to how they are identified using the coco dataset is made. Without going too deep into the technical information, present-day examples are stated that they can relate to. Once such example is from the movie WALL.E, wherein Wall.E (Waste Allocation Load Lifter: Earth)collects and assembles waste left by post-apocalyptic humans and shapes them into boxes. The robot conveniently avoids destroying the objects that it can recognize such as lighters, jewelry boxes and bobble-heads and places them as souvenirs in his house. Voice activated AI like Siri and Alexa are also be demonstrated where they respond to commands that alter the environment of the room. WALL E's Day at Work